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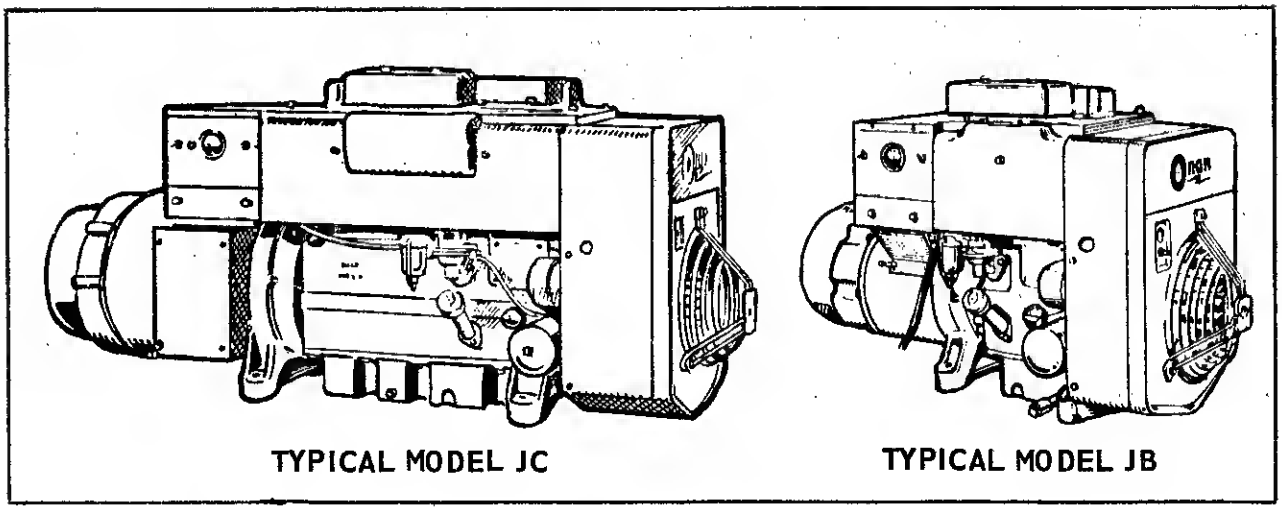
ONAN
ELECTRIC GENERATING PLANTS
JB-JC
SERIES

967-500 IIAT,AT7I



TYPICAL MODEL JC

TYPICAL MODEL JB

GENERAL INFORMATION

This manual contains information required for proper maintenance, servicing and overhaul of Onan JB and JC electric generating plants. Onan recommends that you study the entire manual to better understand how the plant functions. This will help in maintenance and servicing of the plant, which will result in longer life and more reliable operation.

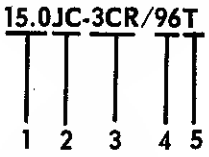
Two and four cylinder electric generating plants are included in this manual because of the similarity between them. Unless otherwise specified, all instructions and procedures apply to both.

If possible, use a parts catalog with the service manual. The parts catalog will give a good picture of assembly and disassembly and help in identifying plant components. Since the first and most important part of repair work is correct diagnosis of the trouble, a troubleshooting chart is included to help find the fault.

A list of special tools is included in the manual. These are available from Onan, and will make it easier to work on the plant.

When discussing left side and right side in this manual, view the plant from the engine end of the plant, which is designated the front end.

HOW TO INTERPRET MODEL AND SPEC NO.



1. Indicates kilowatt rating.
2. Factory code for general identification purposes.
3. Combines with 1 and 2 to indicate Model No.
   - "3" indicates voltage (120/240)
   - "C" indicates reconnectible
   - "R" indicates remote starting
4. Factory code for specific optional equipment supplied.
5. Specification (Spec Letter). Advances with factory production modifications.

705 JB-3R/4703 P

MUFFLERS:

MAXIM SILENCERS DIVISION → DIV of AMF
318-868-4441 80 South Vine St
Mr. Willers or Mr. Bradford Meriden, Conn
203-237-5541

	MODEL	pipe size	LIST	OD x L & WT
①	MUL	1 1/2	30 –	5 3/4" x 24" x 22#
②	MU-3	1 1/2	76 –	7 1/8 x 32 7/8 x 30#
③	MU-2	1 1/2	77	7 1/8 x 51 3/4 x 50#

8 OCTAVES 20-75 75-150 etc

SPECIFICATIONS

NOMINAL DIMENSIONS OF PLANT (INCHES)

50 CYCLE	5.0JB	5.0JB	6.1JB	6.1JB	6.0JB	6.0JB	10.0JC	12.5JC
60 CYCLE	6.0JB	6.0JB	7.6JB	7.6JB	7.5JB	7.5JB	12.5JC	15.0JC
STARTING METHOD	Manual	Remote	Manual	Remote	Manual	Remote	Remote	Remote
HEIGHT	25	25	25	25	25	25	25	25
WIDTH	18	18	18	18	18	18	19	19
LENGTH	36	36	42	36	37	37	51	55

RATINGS (OUTPUT IN WATTS)

TYPE OF SERVICE	5.0JB 6.0JB	6.1JB 7.6JB	6.0JB 7.5JB	10.0JC 12.5JC	12.5JC 15.0JC
50 Cycle Intermittent	5000	6100	6000	10,000	12,500
50 Cycle Continuous	4000	6100	6000	8000	12,500
60 Cycle Intermittent	6000	7600	7500	12,500	15,000
60 Cycle Continuous	5000	7600	7500	10,000	15,000

	★5.0JB 6.1JB †6.0JB 7.6JB	★6.0JB †7.5JB	JC Series
Number of Cylinders (Vertical-in-line)	2	2	4
Displacement (cubic inches)	60	60	120
Cylinder Bore	3-1/4	3-1/4	3-1/4
Piston Stroke	3-5/8	3-5/8	3-5/8
RPM (60 Cycle)	1800	1800	1800
RPM (50 Cycle)	1500	1500	1500
Compression Ratio (Gasoline Fuel)	6.5: 1	6.5: 1	6.5: 1
Compression Ratio (Natural Gas and LPG Fuel)	9.2: 1	9.2: 1	9.2: 1
Oil Capacity (Quarts)	3 *	3 *	6 *
Ignition (Remote Start Plants) - Battery	Yes	Yes	Yes
Ignition (Manual Start Plants) - Flywheel Magneto	Yes	Yes	No
Battery Voltage (Remote Start AC Plants)	12	12	12
Battery Size (Remote Start AC Plants)			
SAE Group 1H	Two in Series	–	–
SAE Group 3KMB	–	One	One
Amp Hour SAE Rating - 20 Hour (Nominal)	105	72	72
Starting System			
Hand Crank Only (Manual Start Plants)	Yes	Yes	–
Exciter Cranking (Remote Start Plants)	Yes	No	No
Solenoid Shift Starting Motor with Overrunning Clutch	No	Yes	Yes
Battery Charge Rate (Amperes)	2	2	2
Ventilation Required (CFM at 1800 RPM)			
Engine (Pressure Cooling)	520	520	890
Engine (Vacu-Flo Cooling)	610	610	1600
Generator Air	75	126	126
Combustion Air	32	32	64
Output Rated at Unity Power Factor Load	All	1-Phase	1-Phase
Output Rated at 0.8 Power Factor Load	No	3-Phase	3-Phase
AC Voltage Regulation in ±%	5	3	3
AC Frequency Regulation in %	5	5	5
Revolving Armature Generator	Yes	No	No
Revolving Field Generator	No	Yes	Yes
120/240 Volt Single Phase Model Reconnectible	No	Yes	Yes
Rotating Exciter	Yes	No	No
Static Exciter (Magneciter)	No	Yes	Yes

★ - Basic 50 cycle model.
† - Basic 60 cycle model.
* - Plus ½ quart for filter.

DIMENSIONS AND CLEARANCES

All values in inches unless otherwise specified.

	SERIES JB	SERIES JC
CAMSHAFT		
Bearing Journal Diameter, Front	2.500 - 2.505	2.500 - 2.505
Bearing Journal Diameter, Rear	1.1875 - 1.1880	1.1875 - 1.1880
Bearing Journal Diameter, Center	–	1.2580 - 1.2582
Bearing Clearance Limit	.0012 - .0037	.0012 - .0037
End Play, Camshaft	.007 - .039	.007 - .039
	Prior to Spec P	Prior to Spec P
Cam Tappet Diameter	.7475 - .7480	.7475 - .7480
Cam Tappet Hole Diameter	.7505 - .7515	.7505 - .7515
	Begin Spec P	Begin Spec P
Cam Tappet Diameter	.8725 - .8730	.8725 - .8730
Cam Tappet Hole Diameter	.8755 - .8765	.8755 - .8765
CONNECTING RODS		
Large Bore Diameter	2.1871 - 2.1876	2.1871 - 2.1876
Small Bore Diameter	1.044 - 1.045	1.044 - 1.045
Clearance, Bearing-to-Crankshaft	.001 - .003	.001 - .003
CYLINDER		
Cylinder Bore	3.250	3.250
CRANKSHAFT		
Main Bearing Journal Diameter	2.2440 - 2.2445	2.2430 - 2.2435
Main Bearing Clearance	.0014 - .0052	.0024 - .0052
Connecting Rod Journal Diameter	2.0600 - 2.0605	2.0600 - 2.0605
Rod Bearing Clearance	.001 - .003	.001 - .003
End Play, Crankshaft	.010 - .015	.010 - .015
PISTON		
Piston Clearance to Cylinder Wall (Measure 90° to Pin, Just Below Oil Ring Groove)	.0012 - .0032	.0012 - .0032
PISTON PIN		
Piston Clearance	Thumb Push Fit	Thumb Push Fit
Connecting Rod Bushing Clearance	.0002 - .0007	.0002 - .0007
PISTON RINGS		
Ring Gap	.010 - .020	.010 - .020
Ring Width, Top	.0925 - .0935	.0925 - .0935
2nd	.0925 - .0935	.0925 - .0935
3rd	.1860 - .1865	.1860 - .1865
VALVE, INTAKE		
Stem Diameter	.3405 - .3415	.3405 - .3415
Guide Clearance	.001 - .003	.001 - .003
Valve Face	42°	42°
Valve Clearance, Begin Spec D	.012 (0.013)	.012
Prior to Spec D	.010	.010
VALVE, EXHAUST		
Stem Diameter	.3405 - .3415	.3405 - .3415
Guide Clearance	.0030 - .0050	.0030 - .0050
Valve Face	45°	45°
Valve Clearance, Begin Spec D	.015 (0.013)	.015
Prior to Spec D	.013	.013

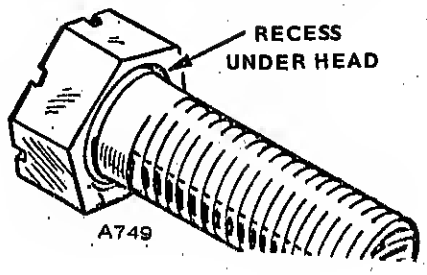
	SERIES JB	SERIES JC
VALVE GUIDE		
Length	1-25/32	1-25/32
Outside Diameter	.4690 - .4695	.4690 - .4695
Inside Diameter (After Reaming) Exhaust	.344 - .345	.344 - .345
Intake	.342 - .343	.342 - .343
Cylinder Block Bore Diameter	.467 - .468	.467 - .468
VALVE SEATS (Stellite)		
Valve Seat Bore		
Diameter, Intake	1.547 - 1.548	1.547 - 1.548
Exhaust	1.361 - 1.362	1.361 - 1.362
Depth (From Cylinder Head Face)	.433 - .439	.433 - .439
Seat Insert Outside Diameter, Exhaust	1.364 - 1.365	1.364 - 1.365
Intake	1.550 - 1.551	1.550 - 1.551
Seat Width	3/64 - 1/16	3/64 - 1/16
Seat Angle	45°	45°
Available Oversizes	.002, -005	.002, .005
VALVE SPRINGS		
Load, Valve Closed	45-49 lb. Prior to Spec P	45-49 lb. Prior to Spec P
Load, Valve Open	83-93 lb. Begin Spec P	83-93 lb. Begin Spec P
Load, Valve Open	87.2 - 97.2	87.2 - 97.2
SPARK PLUGS		
Spark Plug Gap	.025	.025
CENTRIFUGAL SWITCH		
Breaker Point Adjustment	.020	.020
MAGNETO		
Pole Shoe Gap	.020	–
BREAKER POINT SETTING		
Gap	.020	.020
Distributor Dwell Angle (If Using Dwellmeter)	–	51°
TAPPETS		
Gasoline, Intake	.012	.012
Exhaust	.015	.015
Gas and Gas/Gasoline, Intake	.013	.013
Exhaust	.020	.020
IGNITION TIMING SPARK ADVANCE		
(Running) Gas Fuel	35°BTC	35°BTC
(Stopped) Gas Fuel	5°BTC	*10°BTC
(Running) Gasoline Fuel		
Flywheel Magneto	25°BTC	–
Battery	25°BTC	25°BTC
(Stopped) Gasoline Fuel		
Flywheel Magneto	5°ATC	–
Battery	5°ATC	**0°BTC

* - 20°BTC for units with shielded distributor.
** - 10°BTC for units with shielded distributor.

ASSEMBLY TORQUES AND SPECIAL TOOLS

Assembly torques assure proper tightness without danger of stripping threads. If a torque wrench is not available, estimate the degree of tightness. Use reasonable force and a wrench of normal length.

Special Place Bolts do not require lockwashers or gaskets. Never attempt to use a lockwasher with these bolts, it will defeat their purpose. Check all studs, nuts and screws often. Tighten as needed.



TORQUE SPECIFICATIONS	FT.-LB.
Center Main Bolt (4 cyl.)	97-102
Connecting Rod Bolt	27-29
Cover-Rocker Box	8-10
Cylinder Head Bolt	28-30
Exhaust Manifold Nuts	13-15**
Flywheel Mounting Screw	65-70
Hub to Flywheel Screws (4cyl.)	17-21
Fuel Pump Mounting Screws	15-20
Gear Case Cover	15-20
Intake Manifold	13-15
Oil Base Mounting Screws	45-50
Oil Filter	Hand Tight Plus 1/4 to 1/2 Turn
Oil Pump Mounting Screws	15-20
Rear Bearing Plate	40-45
Rocker Arm Nut	4-10*
Rocker Arm Stud	35-40
Through-Stud-Nut	
Revolving Armature	30-40
Revolving Field	55-60

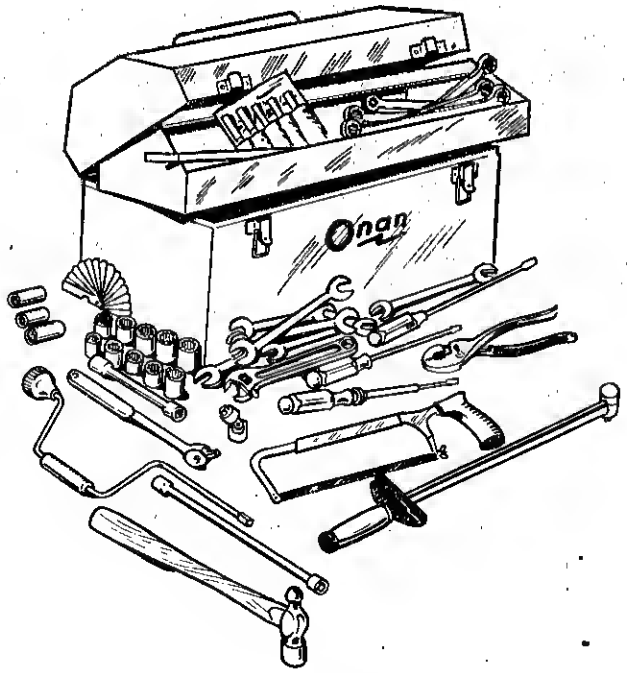
* - This torque is from friction between the threads only and locks the nuts in place. The rocker arm nuts are for adjusting valve lash.

** - Caution: Tighten nuts evenly to avoid manifold damage.

SPECIAL TOOLS AND EQUIPMENT

These tools are available from Onan to aid service and repair work.

Connecting Rod Aligning Set	420P173
Crankshaft Gear Pulling Ring	420A275
Driver, Front Camshaft Bearing	420A252
Driver, Rear Camshaft Bearing	420B251
Driver, Center Camshaft Bearing (4 cyl.)	420B254
Driver, Main Bearing Front and Rear (4 cyl.)	420B269
Driver, Valve Seat	420B270
Rear Oil Seal Guide and Driver	420B250
Front Oil Seal Guide and Driver	420B281
Replacement Blades for 420B272	420B274
Ridge Reamer	420P260
Ring Compressor	420P214
Valve Spring Compressor Tool	420A210
Valve Seat Remover	420A272
Replacement Blades	420A274



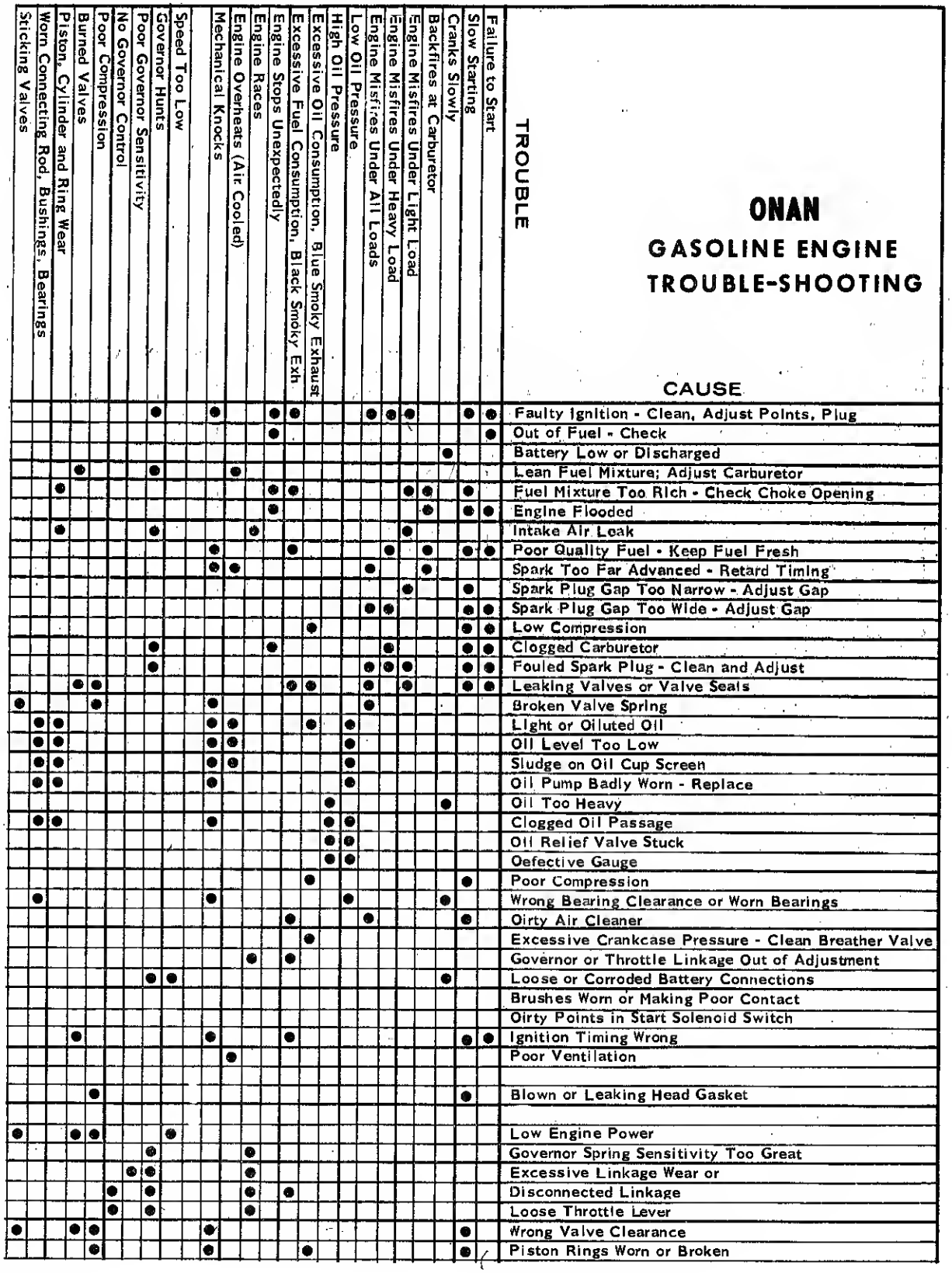
PERIODIC SERVICE GUIDE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS					
	8	100	200	500	1000	5000
Inspect Plant Generally	x					
Check Fuel Supply	x					
Check Oil Level	x					
Clean Crankcase Breather			x			
Check Governor Linkage		x*				
Service Air Cleaner		x*				
Change Crenkcase Oil		x*				
Check Breaker Points			x			
Check Battery Electrolyte Level			x			
Empty Fuel Sediment Bowl			x			
Inspect Generator Brushes				x		
Clean Breather Baffle				x		
Replace Oil Filter			x			
†Check Valve Clearance				x		
Clean Rocker Cover Oil Line Holes					x	
Inspect Valves, Grind If Necessary					x	
Clean Generating Plant					x	
Complete Reconditioning						x

* - Service more often under extreme dust conditions.

† - Tighten head bolts and adjust valve clearance after first 50 hours on a new or overhauled engine.

ENGINE TROUBLESHOOTING



COOLING SYSTEM

JB and JC electric plants use a pressure air cooling system. Blades on the engine flywheel draw air into the front of the engine housing and force it past all the cylinders and out the right side of the engine. A separate blower on the generator rotor draws air into the rear of the generator and forces it out openings near the engine. The engine air outlet may use an air duct and an optional shutter assembly.

MAINTENANCE

Clean the engine cooling area (fins on cylinder block and cylinder heads) at regular intervals, normally every 1000 hours but more often under dirty operating conditions.

OVERHEATING

Overheating in an air cooled engine is difficult to discover. The first sign is usually a vapor lock in the fuel system, and the second scored pistons.

The usual causes of overheating are dirty cooling surfaces, operating without the engine air housing, and incorrect installation.

CAUTION *The air housing including the door must be on when operating the engine. Overheating and permanent damage could result from as little as one minute of full load operation without it.*

The most common installation problems leading to overheating are:

1. Installation with duct size too small so air flow is insufficient.
2. Installation in small room with no ducts and insufficient air ventilation in the room.
3. Installation of air inlet and outlet ducts so air outlet feeds back to the inlet.

AIR SHUTTER (Optional)

The shutter assembly mounts on the engine air outlet on the right side of the cylinder shroud (Fig. 2). A thermostatic element (Fig. 3) controls the shutter closing which limits air flow when the engine is cold. When the air temperature reaches 120°F the element plunger begins to move outward, opening the shutters. The shutters are completely open by 140°F.

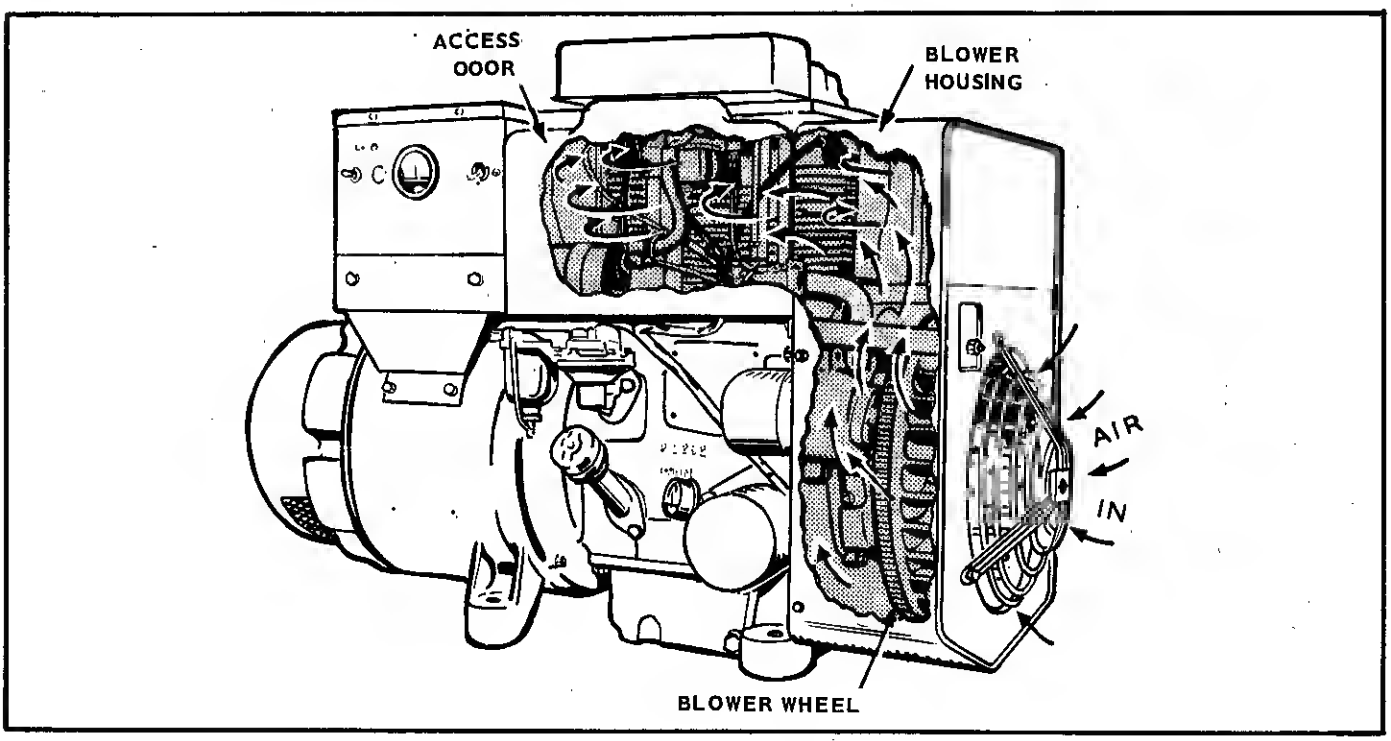


FIGURE 1. COOLING AIR FLOW

NOTE: *On early models, a high temperature cut-off switch mounts on the air shutter assembly.*

Tbe shutter opening temperature isn't adjustable. The power element plunger must contact the shutter roll pin at room temperature. To adjust, loosen the power element mounting screws and slide the assembly until it touches the roll pin with the shutter closed (Fig. 3).

REPAIR: If the shutter won't open, check the power element for defects, binding of the plunger, and the shutter for binding against the housing.

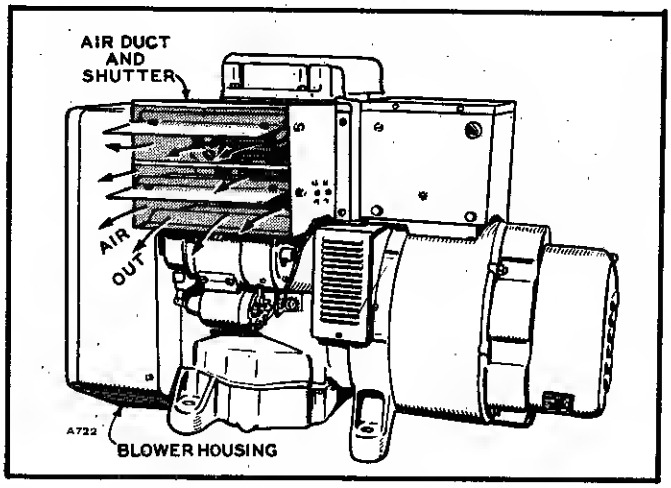


FIGURE 2. SHUTTER ASSEMBLY

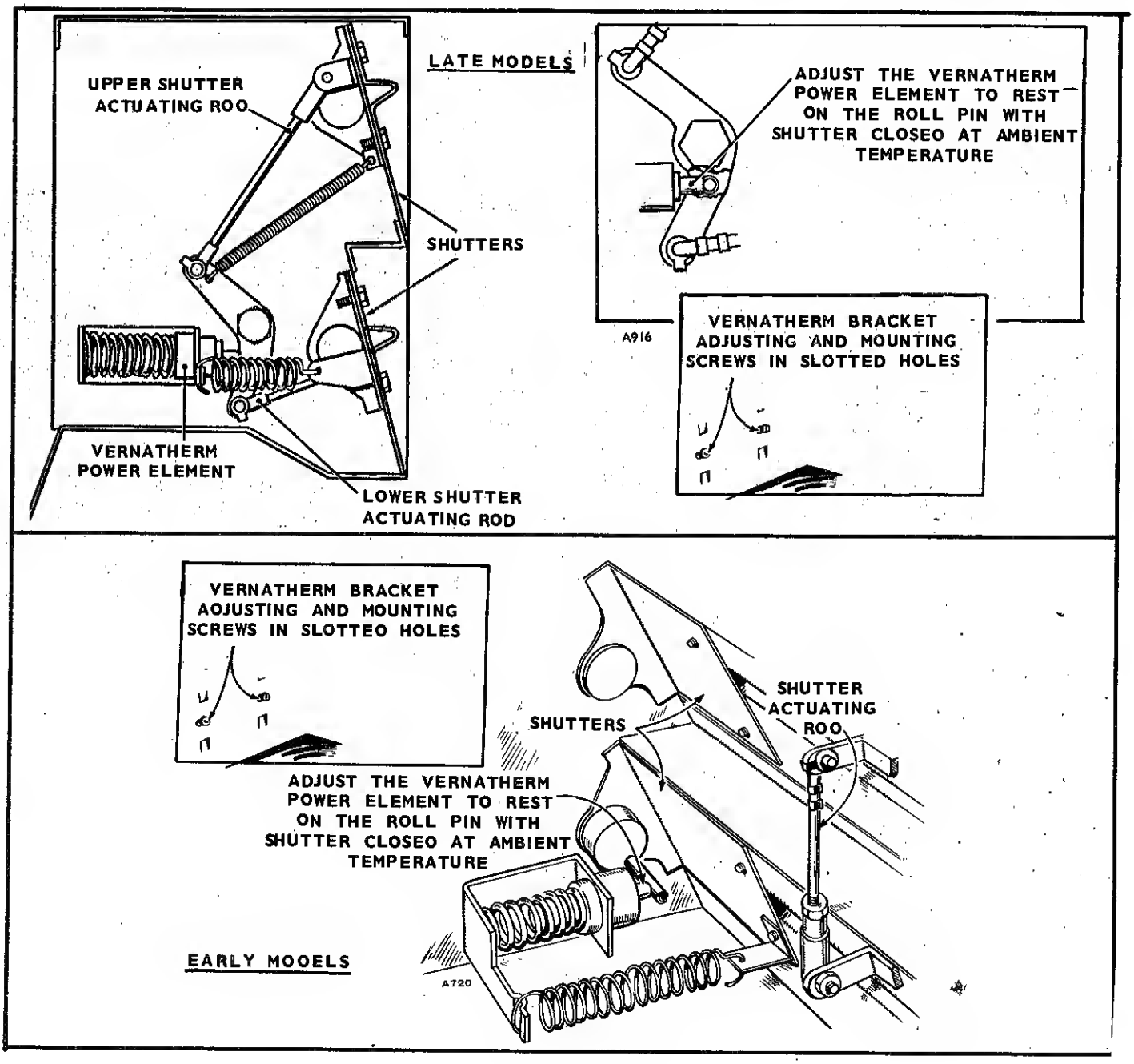


FIGURE 3. SHUTTER MECHANISM

To test the power element, remove it from the assembly and apply heat. When the element reaches about 120°F, the plunger should start to move out. Total movement should be at least 13/64 in.

If the shutter won't close, check for a weak return spring, binding in the nylon bearings, or dirt in the power element plunger. If the nylon bearings are worn or bind, replace them. Remove the shutters and pull out the stub shafts. Push out the old bearings and push in new bearings from the inside of the shutter housing. The larger bearing surface acts as a spacer bushing and must be on the inside of the housing.

NOTE: Do not lay tools or any heavy objects on top surface of shutter assembly or cause any condition that may distort or dent the air duct shutter sheet metal housing.

This distortion may cause binding in the nylon bushings upon which shutters ride and prevent full shutter opening.

Lubricate nylon shutter bushing with high temp silicone grease.

FUEL SYSTEM

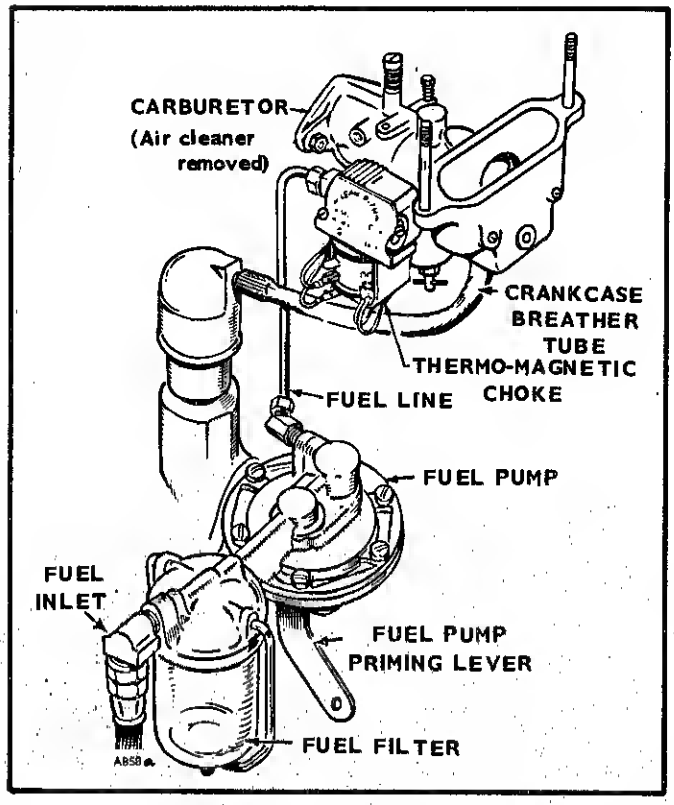


FIGURE 4. GASOLINE FUEL SYSTEM

Standard JB and JC engioes use a gasolioe carbureted fuel system to deliver a mixture of fuel and air to the combustion chamber. The system draws fuel from a tank, delivers it through a filter and fuel pump to the carburetor float chamber. Air passing through the carburetor veoturi section draws fuel from the float chamber.

Options: A combination gasoline-gaseous fuel carburetor or straight gaseous fuel carburetors are available for use with gaseous fuels. A gaseous fuel system uses a fuel regulator (Fig. 5) to control the flow of gas from the lines to the carburetor. At the carburetor, the gaseous fuel is mixed with the incoming air.

All fuel system components are described in the following paragraphs. Select the components that apply to your plant.

FUELS

Use regular grade gasoline. Premium fuels contain more Tetra Ethyl lead than regular; the lead quantity also varies between fuel brands. In constant speed operation, the buildup of deposits in the combustion chambers ia proportional to the amount of lead in the gasoline.

Excessive lead causes more dcposits and more frequent head removal for cleaning. If planta require frequent combustion chamber cleaning, the period betwaen cleaning can often be increased by changing fuel.

It fuel is stored for any great length of time, it can oxidize and form gums – the fuel becomes stale. ONAN recommends changing fuel stored as often as every season to iosure fresh fuel, especially where there is a great change in weather between seasons.

MAINTENANCE

On gasoline fuel systems, periodic maintenance consists of

ALGAS REGULATOR

GARRETSON REGULATOR

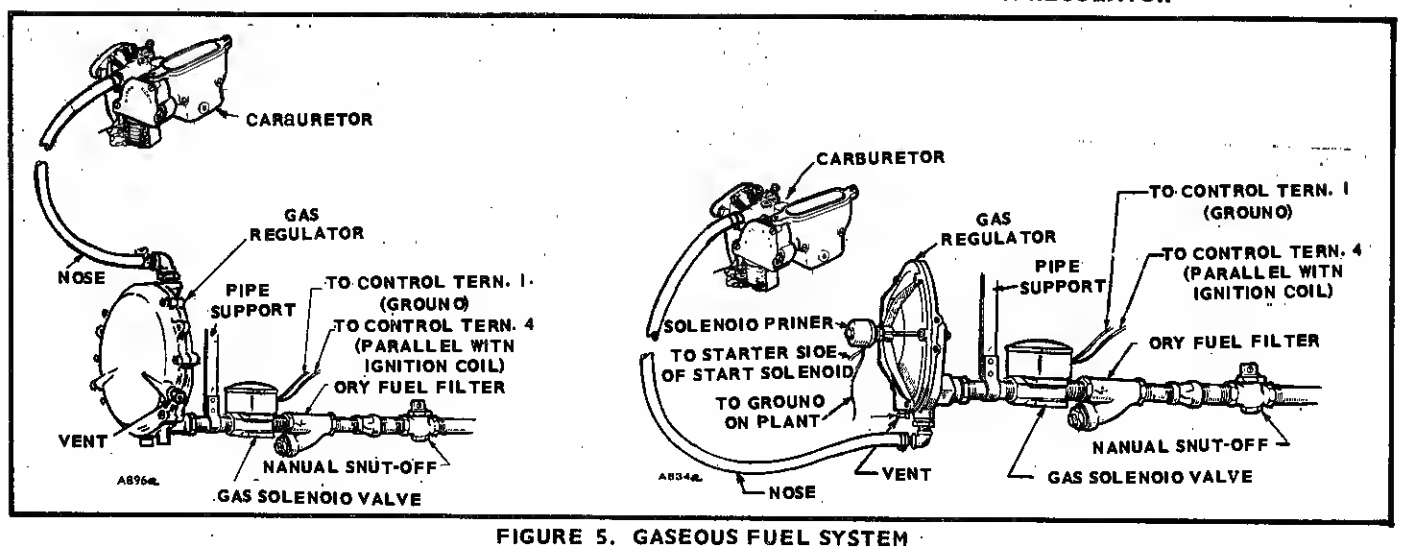


FIGURE 5. GASEOUS FUEL SYSTEM

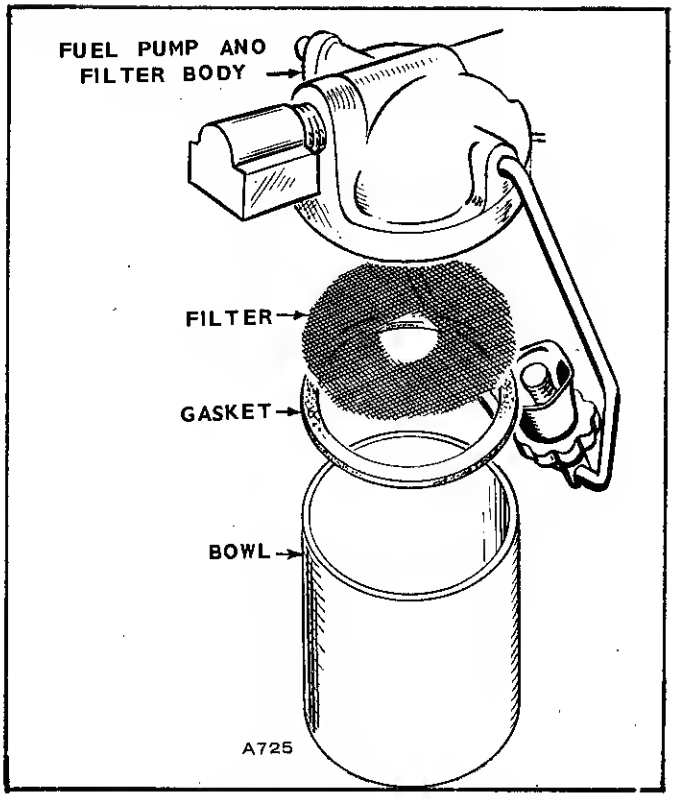


FIGURE 6. FUEL SEDIMENT BOWL

cleaning the fuel strainer, cleaning or replacing the air cleaner, carburetor adjustment, and complete carburetor cleaning.

To clean the fuel strainer, remove the fuel sediment bowl and the screen (Fig. 6) and thoroughly wash the screen. At the same time, remove the carburetor float bowl and clean it. Assemble and check for leaks.

On gaseous fuel systems, periodic service should include cleaning or replacing the air cleaner, carburetor adjustment, inspection of hoses, etc. and cleaning the optional dry fuel filter.

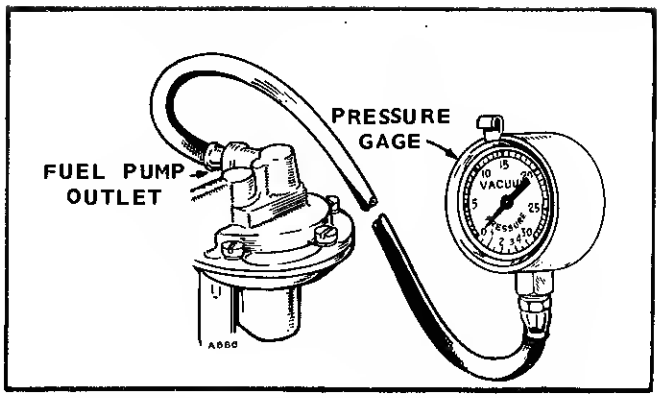


FIGURE 7. CHECKING FUEL PUMP PRESSURE

FUEL PUMP (Gasoline fuel system).

The fuel pump is located on the left side of the engine. If fuel doesn't reach the carburetor, make the following checks:

1. Check the fuel tank and see that the shut-off valve is open.

2. Remove the fuel line from the pump outlet and crank the engine over several times. On manual models, operate the priming lever instead of cranking the engine. Fuel should spurt out of the pump. If not, remove the pump for repair or replacement.

Testing: If the fuel pump delivers fuel, test it with a pressure gauge or manometer. Perform these tests before removing the pump from the engine. Disconnect the pump outlet line and install the pressure gauge (Fig. 7).

Test the valves and diaphragm by operating the priming lever a few times. The pressure shouldn't drop off rapidly after priming has stopped.

Next, run the engine at governed speed on the fuel remaining in the carburetor and measure the fuel pump pressure developed. Pressure should be between 2 and 3 psi with the gauge held 16 in. above the fuel pump.

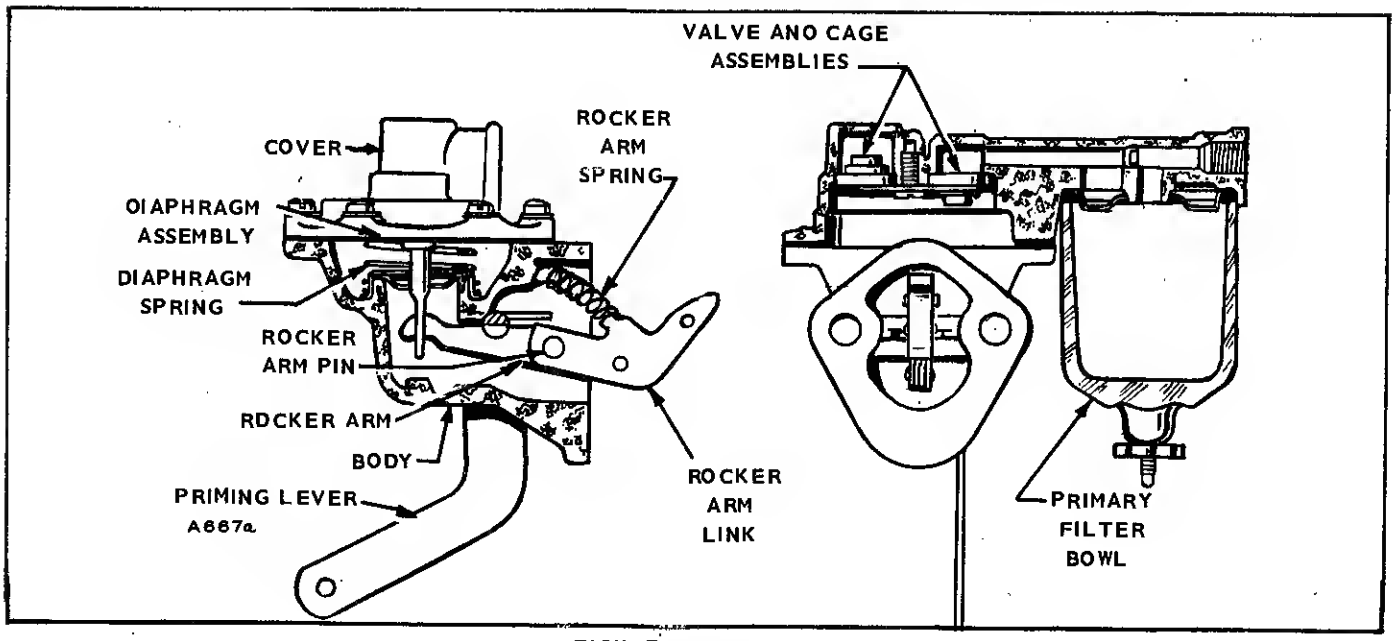


FIGURE 8. FUEL PUMP

A low pressure reading indicates extreme wear in one part or some wear in all parts; overhaul or replace the pump. If the reading is above maximum, the diaphragm is probably too tight or the diaphragm spring too strong. This can also be caused by fuel seeping under the diaphragm retainer nut and between the diaphragm layers, causing a bulge in the diaphragm. Overhaul the pump and replace the defective parts.

Low pressure with little or no pressure leak after pumping stops indicates a weak or broken spring or worn linkage and in most cases the pump should be replaced.

Removal and Disassembly (Fig. 8):

1. Remove the pump inlet and outlet. Remove the two capscrews holding the pump to the engine and lift it off.
2. Notch the pump cover and body with a file for assembly in the same relative position, and remove the six screws holding them together.
3. Tap the body with a screwdriver to separate the two parts. Don't pry them apart – this may damage the diaphragm.
4. Lift out the diaphragm assembly and diaphragm spring.

Repair: Fuel pump failure is usually due to a leaking diaphragm, valve or valve gasket. A kit is available for replacement of these parts. Because the extent of wear cannot easily be detected, replace all parts in the kit. If the diaphragm is broken or leaks, check for diluted crankcase oil.

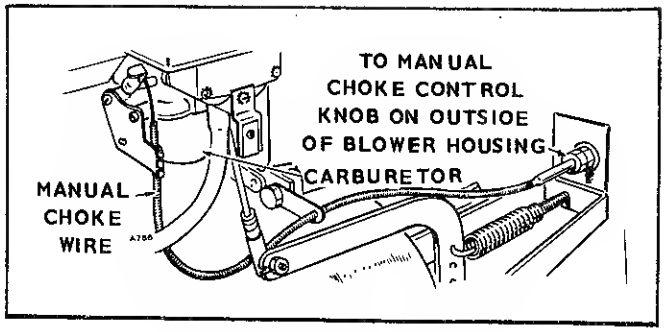


FIGURE 9. MANUAL CHOKE

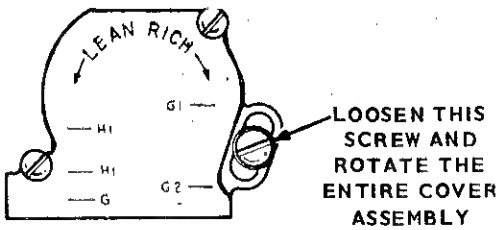
Occasionally, failure is due to a broken or weak spring or wear in the linkage. In this case, install a new pump.

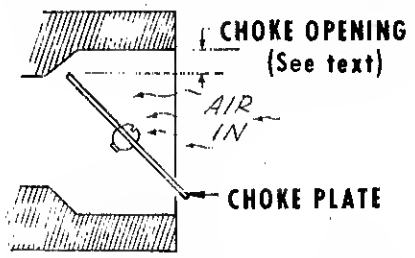
Assembly:

1. Before installing a new diaphragm, soak it in fuel. Insert the diaphragm spring and soaked diaphragm into the pump body.
2. Compress the rocker spring and install between the body and rocker arm.
3. Assemble the cover to the body with notch marks lined up. Install the screws but don't tighten. Push the rocker arm in full stroke and hold in this position to flex the diaphragm.
   NOTE: *The diaphragm must be flexed or it will deliver too much fuel pressure.*
4. Tighten the cover screws alternately and securely, then release the rocker arm.

AMBIENT TEMP. (°F)	60	65	70	75	80	85	90	95	100
CHOKE OPENING (Inches)	1/8	9/64	5/32	11/64	3/16	13/64	7/32	15/64	1/4

SPEC C–R





BEGIN SPEC. S

AMBIENT TEMP. (°F)	75	70	60	50	40	30	20	10
CHOKE OPENING (Inches)	9/16	1/2	15/32	7/16	3/8	11/32	5/16	1/4

FIGURE 10. CHOKE ADJUSTMENTS

5. Install the pump on the engine and repeat the pressure test.

CHOKE (Gasoline fuel system).

Remote starting plants use an automatic electric choke (Fig. 4); manual starting plants use a hand choke (Fig. 9). An electric element controls the automatic electric choke. Before the plant starts, the choke is partially closed. When the plant has started, the generator supplies current to the heating element which heats the bi-metal coil, opening the choke plate.

Adjustment, Electric Choke: Under normal operation, adjust the choke so the distance measured between the choke plate and carburetor throat (Fig. 10) is as shown in the table with the engine cold. Use the straight shank end of a drill bit to measure the gap. The upturned air cleaner must be removed for choke adjustment. To adjust the choke, loosen the two screws on the endplate and rotate the cover assembly.

Operation and Adjustment, Therma-Magnetic Choke: This choke uses a strip heating element and a heat sensitive bi-metal spring to control the choke blade position. A solenoid, actuated during engine cranking, closes the choke all or part way depending on ambient temperature.

The bimetal is calibrated to position the choke to the proper opening under any ambient condition. The choke is adjusted at the factory. If, for any reason, readjustment is required, use the following procedure.

Adjustment must be made with the bimetal at ambient temperature. Do not attempt adjustments until the engine has been shut down for at least one hour. Remove the air cleaner to expose the carburetor throat. Loosen the screw which secures the choke body assembly. Refer to Fig. 10 for correct choke setting according to temperature. Use a drill bit to measure the choke opening. Rotating the choke body clockwise richens and counterclockwise leans the choking effect. Tighten screw that secures choke body.

Disassembly and Repair, Electric and Therma-Magnetic Choke: If the choke does not operate, or will not maintain its adjustment, disassemble it for repair. If it will not close, check for binding, incorrect adjustment, or incorrect assembly of the coil. If it will not open after plant starts, check for heating. The choke should be warm to the touch within a minute or two of plant starting. To disassemble choke refer to Fig. 11.

Electric Choke: If the choke will not heat properly, check for a broken heating coil or high resistance electrical con-

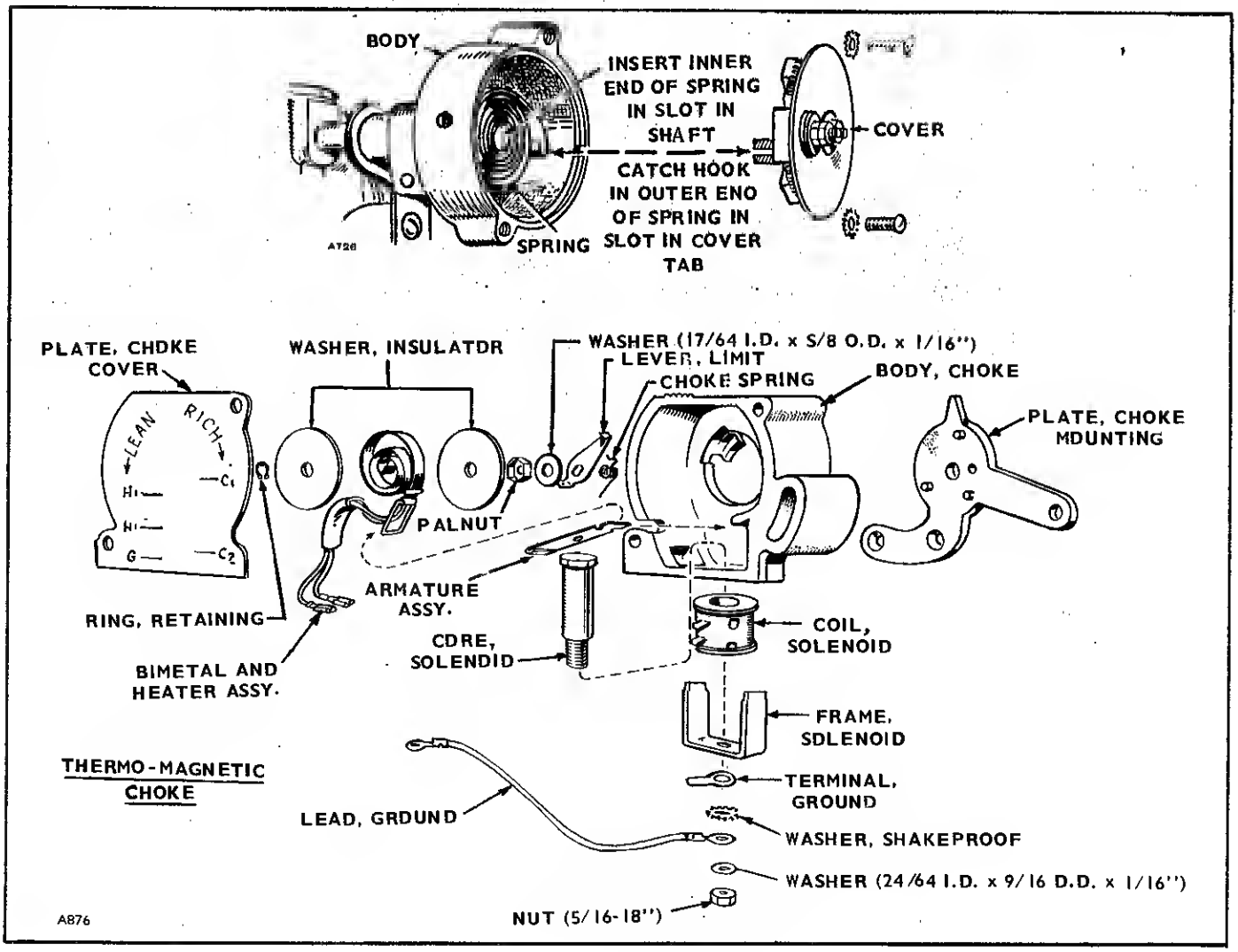


FIGURE 11. EXPLODED VIEW: ELECTRIC CHOKE

nections. Check the coil resistance with an ohmmeter. With the element at room temperature, resistance should be about 5 - 6 ohms for 12-volt models, about 25 ohms for 24-volt models and about 16 ohms for 22-volt models. If the coil is defective, replace the thermostat cover.

Thermo-Magnetic Choke: If choke will not heat properly, check for broken heater wire, high resistance connections or broken lead wires to the bi-metal and heater assembly. With the element at room temperature, check the heater resistance with an ohmmeter. The resistance should be about 30.6 to 37.4 ohms for a 12-volt system. If the heater is defective, replace it with a new one. When the start button is engaged, the solenoid should cause the spring-loaded armature to contact the solenoid core. If this does not occur, check for broken lead wires or a defective solenoid coil. There must be slack in the lead wires between the choke body and the bi-metal and heater assembly. The solenoid coil resistance should be 2.09 to 2.31 ohms in a 12-volt system.

Assembly (Fig. 11): When assembling electric choke be sure the fork in the plate straddles and holds the outer end of the coil and that the spring winds in a clockwise direction from center.

When assembling the thermo-magnetic choke, connect the bi-metal and heater assembly as follows:

1. Lead tagged G to ground terminal on coil solenoid.
2. Lead tagged H to either of the H_1 terminals on the solenoid core.

CARBURETOR GASOLINE

The gasoline carburetor is a horizontal draft type. It consists of three major sections: the bowl and float, idle circuit, and load circuit.

Fuel enters the carburetor through the intake valve (Fig. 12) and passes into the float chamber. The float controls fuel level in the bowl by closing the intake valve when fuel reaches a certain height, and opens it when the fuel level drops.

The idle circuit (Fig. 14) supplies fuel during no load operation and for small loads. The throttle plate is nearly

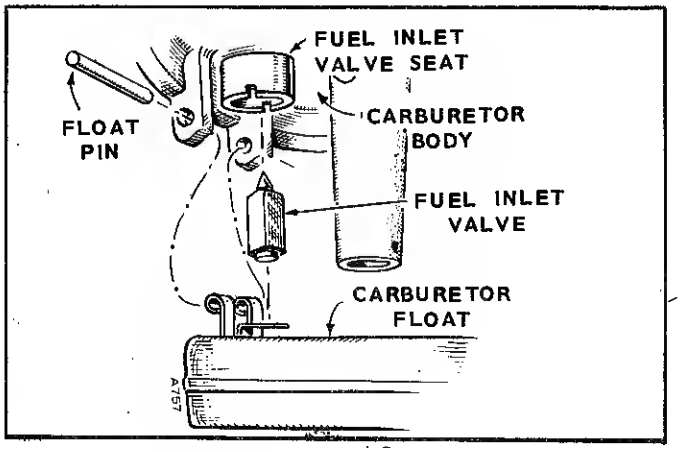


FIGURE 12. FUEL INLET VALVE

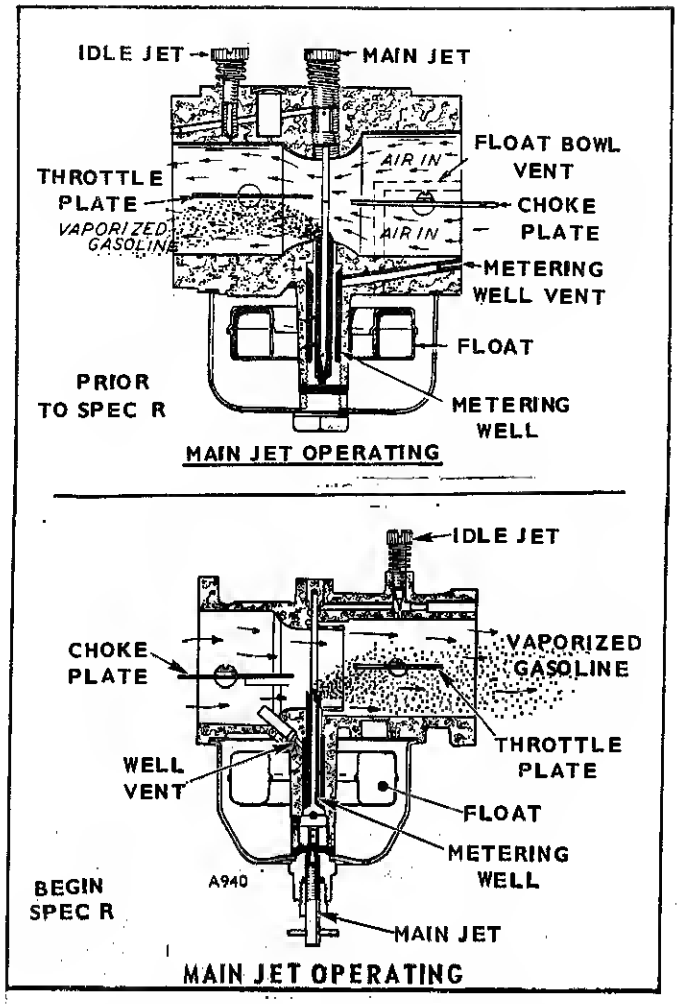


FIGURE 13. MAIN JET OPERATION

closed at no load, and the intake manifold vacuum is high. The pressure difference between the manifold and float chamber causes fuel to flow through the idle circuit. The pressure difference draws fuel up through the hollow center of the main adjusting needle, through passages in the carburetor body to the idle port. Bleed holes in the main adjusting needle allow air to mix with the fuel. When the throttle is almost completely closed, the fuel passes out through the idle port. As the throttle is opened to increase power, it exposes the idle transfer port and fuel is drawn out through this port also.

When the load increases, the engine governor opens the throttle further. The carburetor air flow increases which produces a low pressure at the venturi (narrow section of the carburetor throat). This pressure drop draws fuel up the main nozzle where it mixes with air at the nozzle opening. The main adjusting needle controls fuel delivery.

As the throttle opens, the manifold vacuum decreases so the idle circuit becomes less effective. In a certain range, the two circuits blend, both delivering fuel, but as load is increased, the load circuit takes over.

With the load circuit in operation, as the load is increased, the throttle opens to deliver more fuel. The main nozzle won't immediately deliver this increased fuel because the jet is controlled by the adjusting needle. To prevent a power

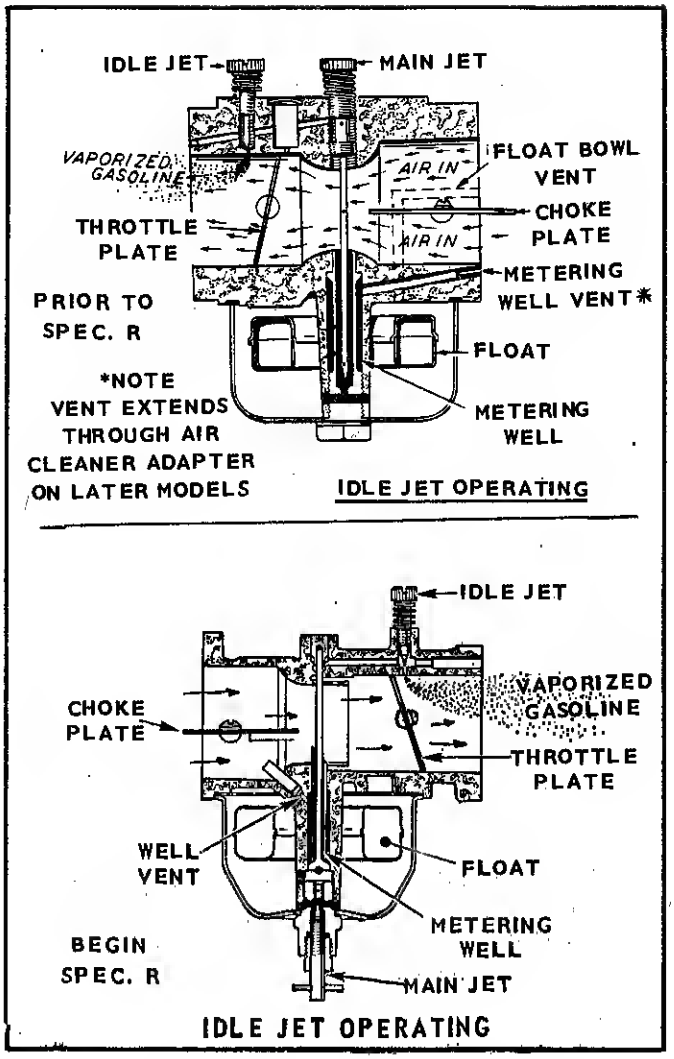


FIGURE 14. IDLE JET OPERATION

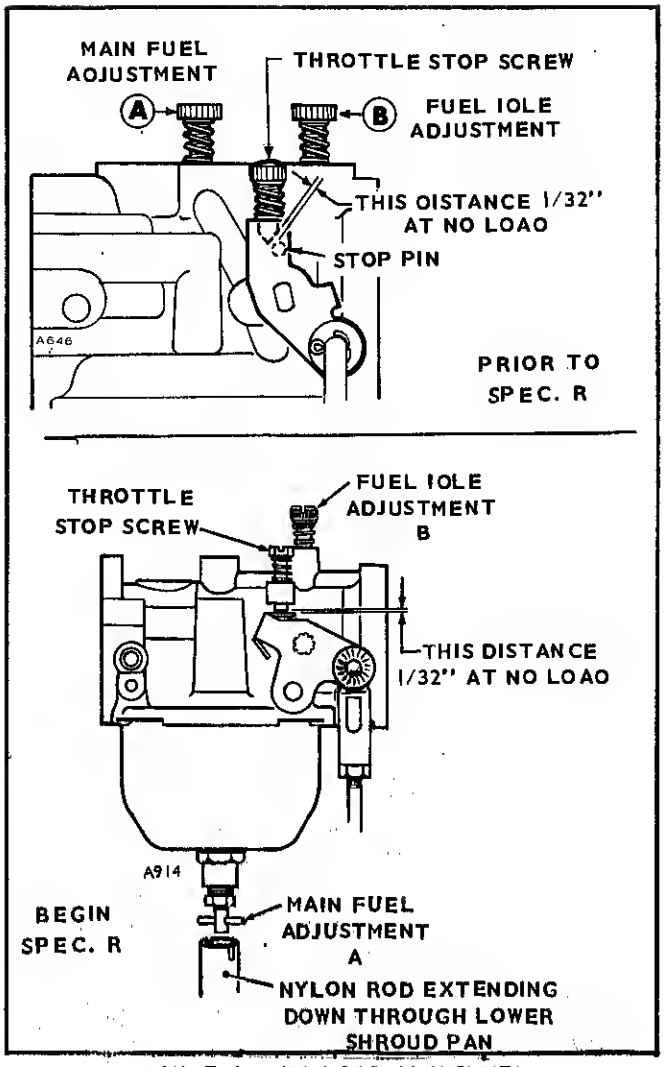


FIGURE 15. NO-LOAD ADJUSTMENT

lag when load is increased, a metering well around the outside of the nozzle delivers fuel until the main jet can catch up with the increased demand.

Adjustment, Gasoline Carburetor: The carburetor should be adjusted in two steps – first the idle adjustment, and then the load adjustment.

NOTE: *If the carburetor is completely out of adjustment so the engine won't run, open both needle valves 1 to 1-1/2 turns off their seats to permit starting. Don't force the needle valves against their seats. This will bend the needle.*

Before adjusting the carburetor, be sure the ignition system is working properly and the governor is adjusted. Then allow the engine to warm up.

1. With no generator load, turn the idle adjustment out until the engine speed drops slightly below normal. Then turn the needle in until speed returns to normal.

2. Apply a full load to the generator. Carefully turn the main adjustment in until speed drops slightly below normal. Then turn the needle out until speed returns to normal.

ALTERNATE METHOD, USE WHEN THERE IS NO LOAD ADJUSTMENT POSSIBLE

1. Start the plant and allow it to warm up. Push in on the governor mechanism to slow the plant down to about 400 - 500 r pm.

2. Set the idle adjustment screw for even operation (so the engine is firing on all cylinders and running smoothly).

3. Release the governor mechanism to allow the engine to accelerate. The engine should accelerate evenly and without a lag. If not, adjust the needle outward about 1/2 turn and again slow down the engine and release the mechanism. Continue until the engine accelerates evenly and without a lag after releasing the governor.

With the carburetor and governor adjusted, and the plant running with no load, (Fig. 15) allow 1/32" clearance to the stop pin. This prevents excessive hunting when a large load is suddenly removed.

Removal and Disassembly:

1. Remove the air housing door and top panel, fuel line, governor linkage and electric choke wire.

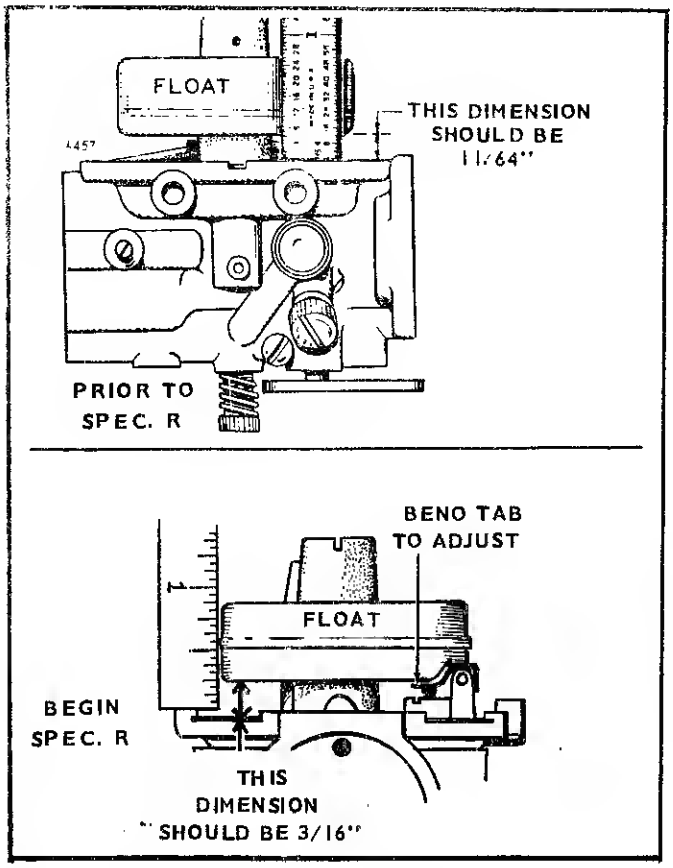


FIGURE 16. FLOAT ADJUSTMENT

2. Remove the two carburetor mounting nuts and pull off the carburetor.

3. Remove the air cleaner adapter and choke from the carburetor.

4. Remove the main fuel adjustment needle (begin Spec. R) and the float bowl nut and pull off the bowl. Remove the float pin and float.

5. Lift out the float valve and unscrew its seat.

6. Remove the no load adjusting needle, the load adjusting needle (Prior to Spec. R) and spring.

7. Remove the throttle plate screws and the plate and pull out the throttle shaft.

8. Remove the choke plate screws and plate and pull out the choke shaft.

Cleaning and Repair: Soak all components thoroughly in a good carburetor cleaner, following the cleaner manufacturer's instructions. Clean all carbon from the carburetor bore, especially in the area of the throttle valve. Blow out the passages with compressed air. If possible, avoid using wire to clean out the passages.

Check the adjusting needles and nozzle for damage. If the float is loaded with fuel or damaged, replace it. The float should fit freely on its pin without binding. Invert the carburetor body and measure the float level (Fig. 16).

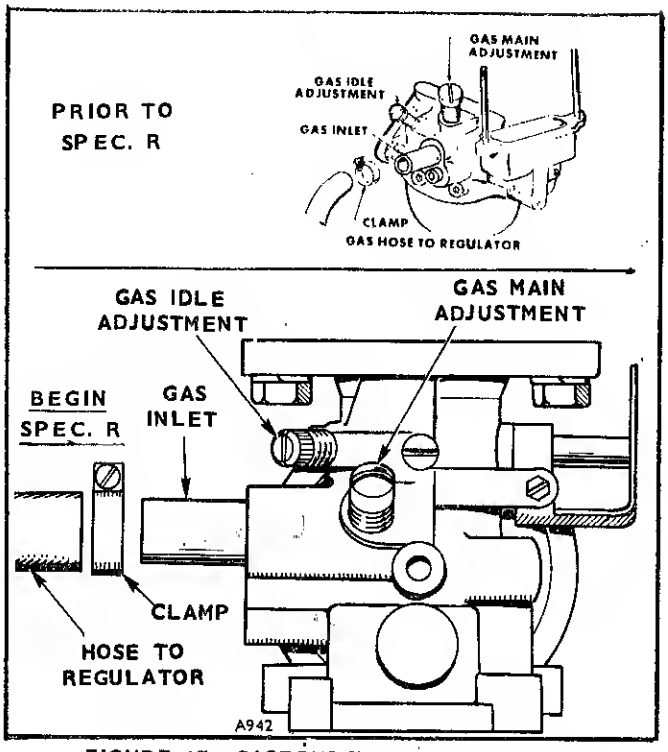


FIGURE 17. GASEOUS FUEL ADJUSTMENTS

To adjust float level, bend the small lip that the intake valve rides on.

Check the choke and throttle shafts for excessive side play and replace if necessary. Don't remove the teflon coating on the throttle shaft which reduces wear and friction between the shaft and carburetor body.

Assembly and Installation:

1. Install the throttle shaft and valve, using new screws. Install as shown in Fig. 13 with the bevel mated to the carburetor body. On valve plates marked with the "C", install with mark on side toward idle port when viewed from flange end of carburetor. To center the valve, back off the stop screw, close the throttle lever and seat the valve by tapping it with a small screwdriver; then tighten the two screws.

2. Install choke shaft and valve. Center the valve in the same manner as the throttle valve (Step 1). Always use new screws.

3. Install the main nozzle (Prior to Spec R) making sure it seats in the body casting.

4. Install the intake valve seat and valve.

5. Install the float and float pin. Center the pin so the float bowl doesn't ride against it.

6. Check the float level with the carburetor casting inverted. See Fig. 16.

7. Install the bowl ring gasket, bowl and bowl nut (and main nozzle begin Spec. R). Make sure that the bowl is centered in the gasket, and tighten the nut securely.

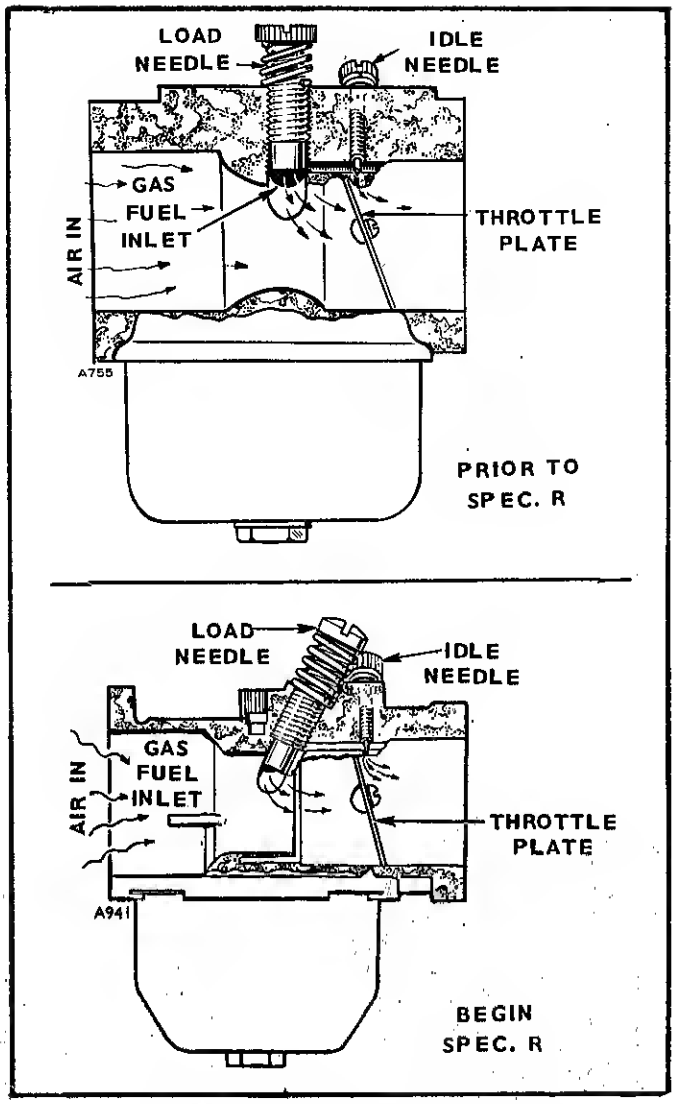


FIGURE 18. CARBURETOR ADJUSTMENTS

8. Install the load adjusting needle with its spring. Turn in until it seats then back out 1 to 1-1/2 turns.

9. Install the idle adjusting screw finger tight. Then back out 1 to 1-1/2 turns.

10. Reinstall the choke and adjust.

11. Install the air horn assembly and gasket.

12. Install the carburetor on the engine and connect the gasoline inlet, governor mechanism breather hose, and choke.

13. Install the air cleaner and the air housing top and door.

CARBURETOR, GASEOUS FUEL

The gaseous fuel carburetor (Fig. 17) is similar to the gasoline carburetor in shape, but it differs in operation. The gaseous carburetor contains two major sections, the idle circuit and the load circuit. Fuel delivery depends on the demand created on the fuel inlet line. A small vacuum on the inlet line opens the fuel regulator, delivering fuel. For no-load operation, the idle adjustment controls the quantity of fuel allowed through the idle port. The throttle plate is almost closed, so the increased vacuum on the engine side of the carburetor draws fuel through the idle passage. When load increases, the flow of air through the carburetor draws fuel from the main fuel port located at the venturi of the carburetor.

Adjustment: Set the carburetor idle adjustment and then the load adjustment.

NOTE: *If the carburetor is completely out of adjustment, so the engine won't run, open the idle adjustment one or two turns, then crank the engine while opening the main adjustment, until the engine starts.*

Adjust the carburetor in the same manner as the gasoline carburetor. Usually the idle adjustment will have little effect on operation, because of the high plant speed.

Removal and Disassembly:

1. Remove the air housing door and top panel, the fuel hose and governor linkage.

2. Remove the 2 carburetor mounting nuts and pull off the carburetor.

3. Remove the float bowl (and main adjustment screw begin Spec. R).

4. Remove the idle adjustment screw and the main adjustment screw (Prior to Spec. R).

5. Remove the throttle plate screws and the plate and pull out the throttle shaft.

Repair and Assembly: Clean in a suitable carburetor cleaner and blow out the idle passage. Check the idle needle for wear or damage and the main adjustment for worn threads. For assembly, reverse the disassembly procedure.

CARBURETOR, COMBINATION GAS-GASOLINE

This carburetor operates on either gasoline or gaseous fuels. To switch operating fuels, make adjustments according to Table I. The combination carburetor consists of both the gasoline and gaseous fuel carburetors on a single casting. Refer to the gasoline and gaseous fuel carburetors for descriptions of operation.

GASEOUS FUEL REGULATOR

The demand type regulator opens upon a small vacuum from the carburetor. It supplies fuel on demand and shuts off fuel flow when the engine is stopped.

The regulator is simply a diaphragm with linkage connecting it to a valve in the gas line. A small vacuum from the engine moves the diaphragm, opening the delivery valve.

Testing: Blow into the diaphragm vent hole on the regulator cover; this should open the valve. An audible hiss indicates that the regulator is opening.

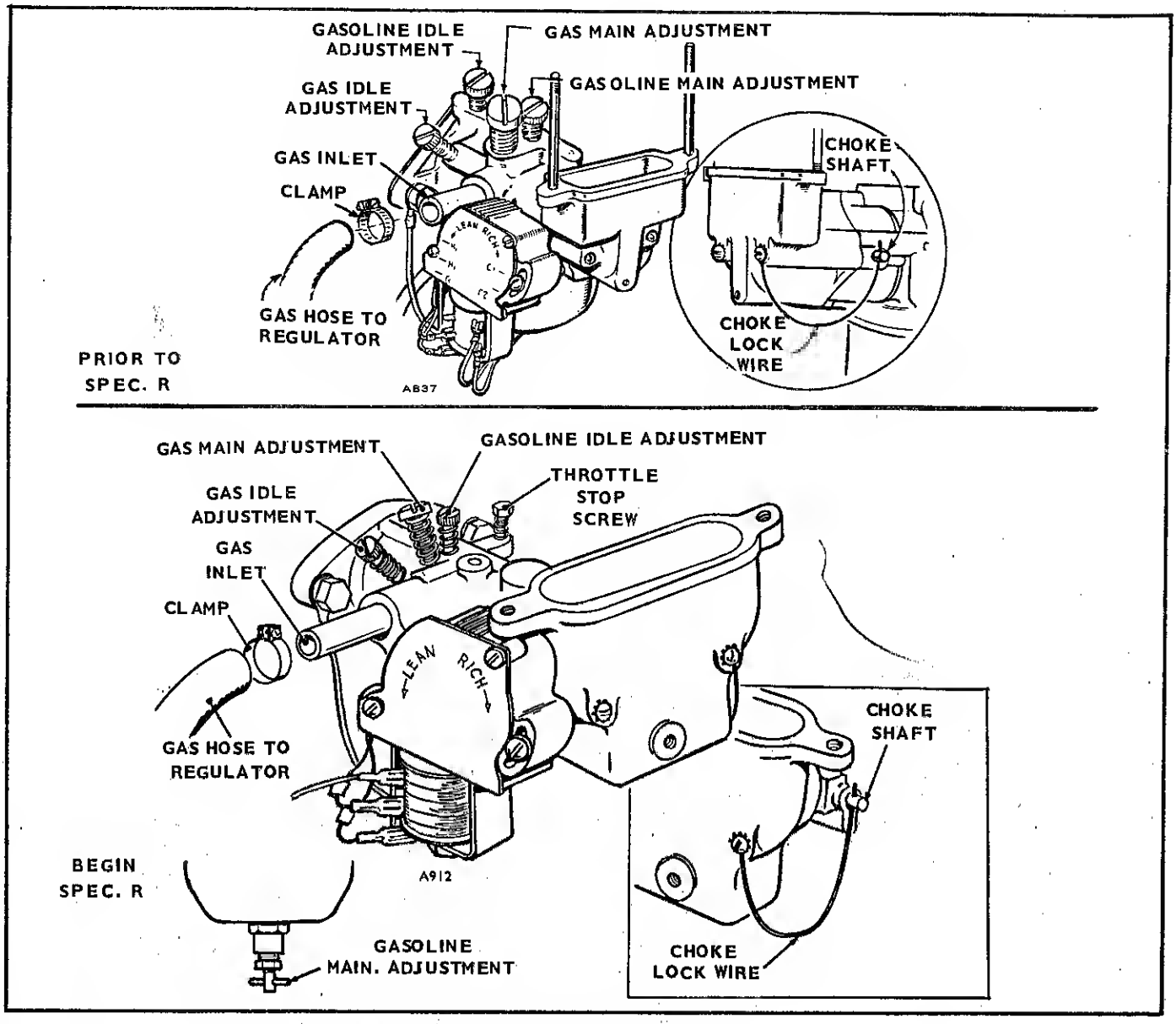


FIGURE 19. GASEOUS FUEL CARBURETOR

TABLE 1.

MODIFICATION	TO GASOLINE	TO GASEOUS FUEL
Gas supply valve	Close	Open
Carburetor float and needle valve	Replace if removed for gas	Remove if for extended operation on gas - reduces wear
Choke	Remove lock wire	Install lock wire
Spark plug gap	Set at .025″	Set at .025″
Gasoline fuel supply valve	Open	Close

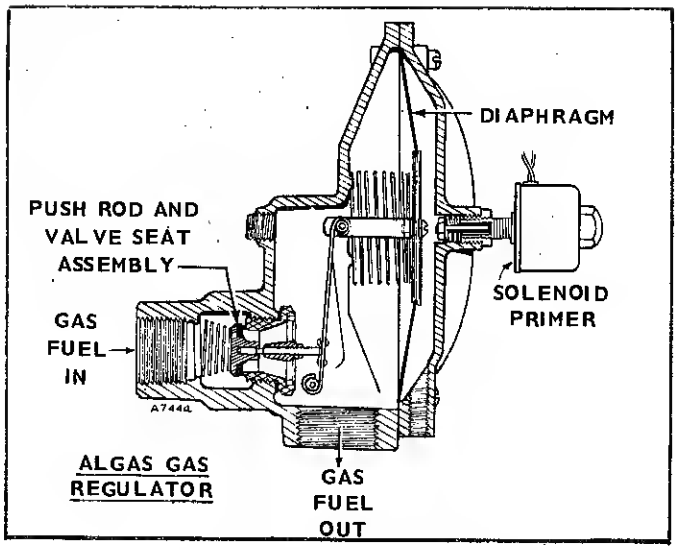


FIGURE 20. ALGAS GAS REGULATOR

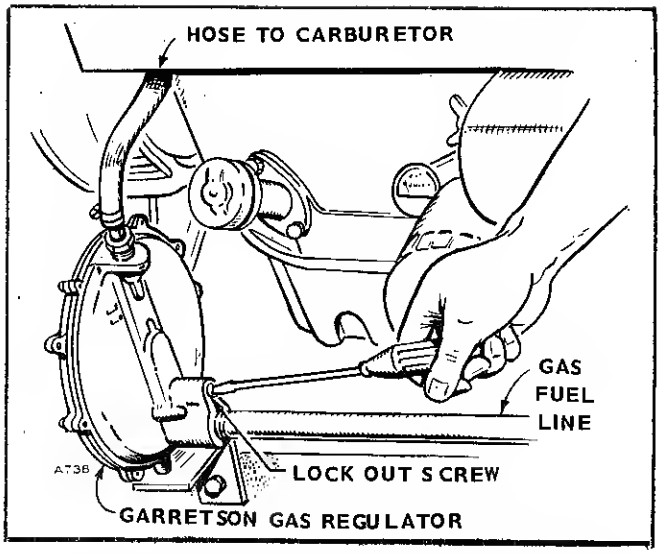


FIGURE 22. GARRETSON GAS REGULATOR

A water manometer (Fig. 21) is the standard tool for testing regulator inlet pressure, which must be within the limits specified for your regulator. Use the chart in Fig. 21 to convert the difference in water level between the 2 tubes to pressure in ounces.

Gas Regulator (Garretson): The maximum allowable inlet pressure is 8 oz; minimum, 2 oz. If gas line pressure is greater than 8 oz., install a primary regulator to reduce the pressure. The regulator has an adjustment to control the maximum pressure at which tbe regulator shuta off when there is no demand. To obtain maximum regulator aenaitivity, adjust it to juat ahut off at your line preasure when there ia no demand. Adjust the regulator for shut off when there is no demand, to prevent gas leaks. The factory adjusted shut-off between 2 and 4 oz. If gas line pressure is between 4 and 8 oz., readjust the screw (Fig. 22).

To adjust the regulator, the gas line should be connected and the outlet hose removed. Make a coarse adjustment by turning the adjusting screw inward until the hissing of escaping gas at the outlet stops. Install a water manometer on the inlet side of the regulator to make the fine adjustment. With the gas on, cover the regulator outlet for a few seconds and then open. If the regulator is leaking, the pressure shown on the manometer will drop slightly or waver indicating that the valve is opening. Turn the screw inward slightly and repeat the test. Continue until the manometer holds steady as the outlet is closed for a few seconds and then opened.

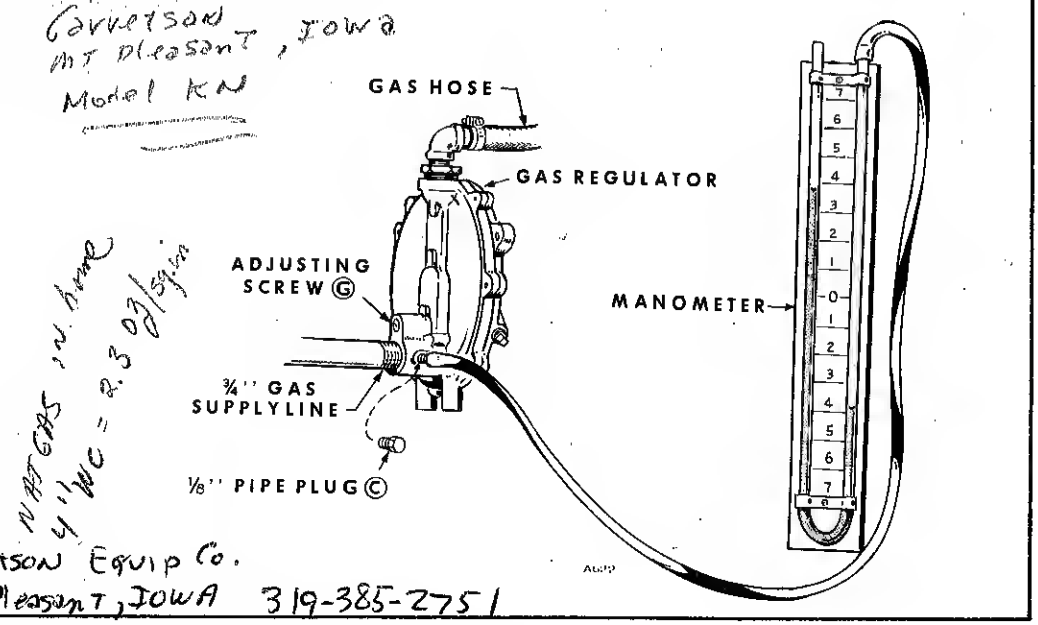
If this regulator appears defective; either won't open, won't close or delivers insufficient fuel, check the shut off pressure adjustment. A kit is available from ONAN to replace both the diaphragm and valve. P/N 148-390 $13.85

Gas Regulator (Algas): The Algas regulator has no adjustments and features a positive lock off if pressure increases above the regulator rating. Maximum inlet pressure is 5 psi and minimum, 6 ounces. NOTE: The standard ONAN supplied solenoid shut off valve #307P312 locks off at a gas inlet pressure of slightly over 1 pound. An optional valve is available with pressure rating to 5 psi.

.OZ	INCHES OF WATER*
1	1.73
2	3.46
3	5.2
4	6.9
5	8.7
6	10.4
8	13.8
10	17.3
12	21
14	24
16	28

*INDICATES EQUIVALENT OF WATER LEVEL DIFFERENCE IN OUNCES

Garretson Mt Pleasant, Iowa Model KN



Natural gas 4" W.C. = 3 oz/sq in

Obtain from Garretson Equip Co. Mt Pleasant, Iowa 319-385-2751

FIGURE 21. TESTING INLET REGULATOR PRESSURE

KIT $14.70 less 25%

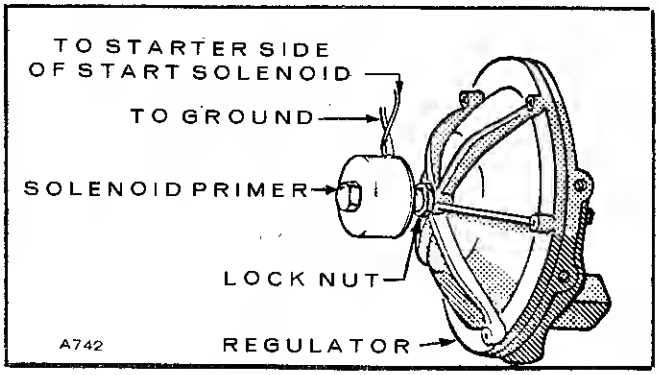


FIGURE 23. SOLENOIO PRIMER

If the regulator doesn't deliver fuel, check the inlet pressure. If pressure is over 5 psi (1 psi with optional solenoid valve) a primary regulator is required to reduce the inlet pressure. If the inlet pressure is within the required limits and the regulator won't deliver fuel or leaks, disassemble it for repair.

To disassemble the regulator, carefully remove the cover and separate the diaphragm from the cover and body. A kit is available from ONAN to repair the regulator.

Solenoid Primer (Algas regulator only): Algas regulators use an optional solenoid primer to provide quick engine starting. The primer (Fig. 23) holds the regulator open during plant cranking. It can be adjusted for a rich or lean mixture by loosening the lock nut and turning the primer in or out. Clockwise richens the mixture.

To adjust for proper priming of a cold engine, set the primer so a hot engine (one with gas in the regulator-carburetor hose and the carburetor) sounds slightly rough and produces slightly dark exhaust after the engine first starts firing.

For a course adjustment:

1. Remove the regulator-carburetor hose at the regulator and apply battery voltage across the primer.
2. Turn the primer clockwise (richer) until you can hear a small flow of gas at the outlet.
3. Remove the voltage, connect the hose and attempt to start the engine.

If the plant starts within three seconds, the primer is correctly adjusted. If not, remove the hose at the regulator and crank the engine for a few seconds to empty the hose and carburetor of gas and readjust the primer slightly. Connect the hose and attempt to start. Continue until the engine starts within three seconds from an empty hose and carburetor. When the primer is properly adjusted, be sure the regulator locks off when the unit is stopped.

To test the primer, remove it from the regulator, noting the number of turns necessary to unscrew it, and operate the start switch. The plunger must extend out. The wiring or primer solenoid may be defective or the plunger is stuck in the primer body.

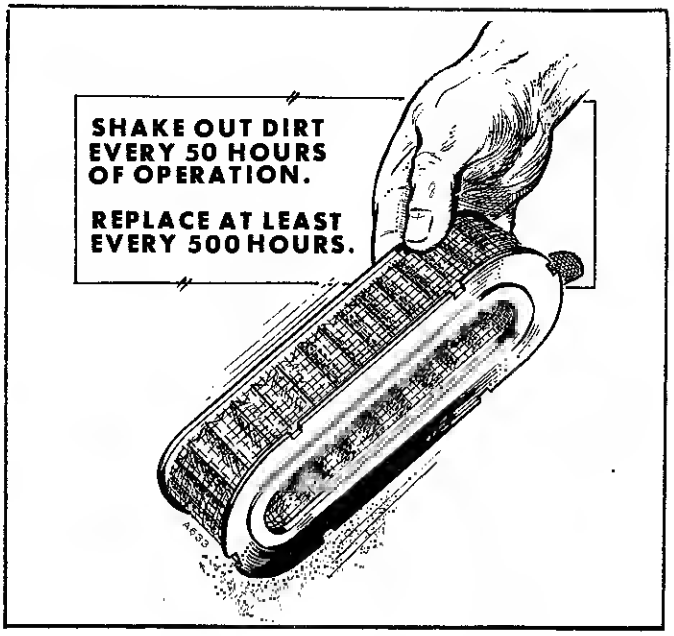


FIGURE 24. PAPER AIR CLEANER

AIR CLEANER

Three types of air cleaners are used. The dry paper type (folded paper), moistened foam type (synthetic sponge) and the oil bath type.

Dry Paper Type: (early JB plants only): Remove and clean either by shaking or blowing out with compressed air at least every 100 hours. Don't wash it. When using compressed air, hold the nozzle far enough from the cartridge so it won't rupture. Replace the cartridge at least every 500 hours. If the paper cartridge has a foam wrapper, remove the wrapper before cleaning, wash it in clean fuel, dry and install on the cartridge.

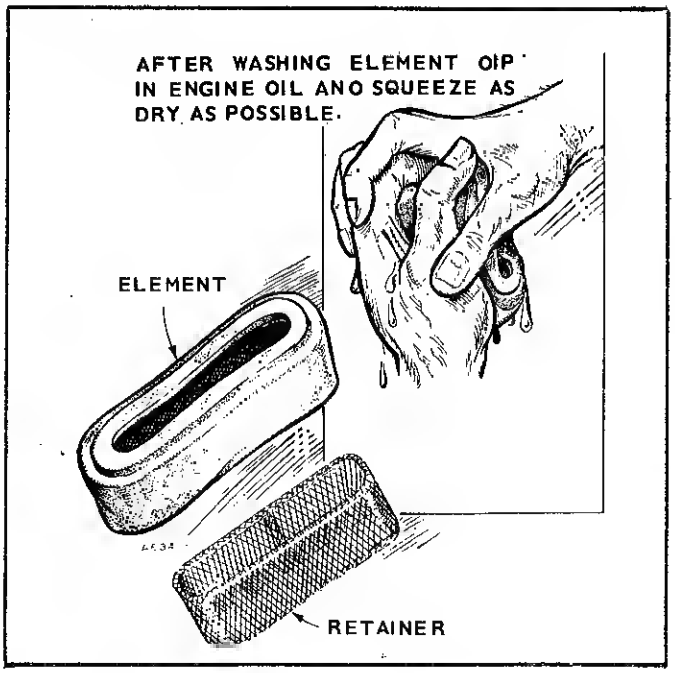


FIGURE 25. MOISTENED FOAM AIR CLEANER

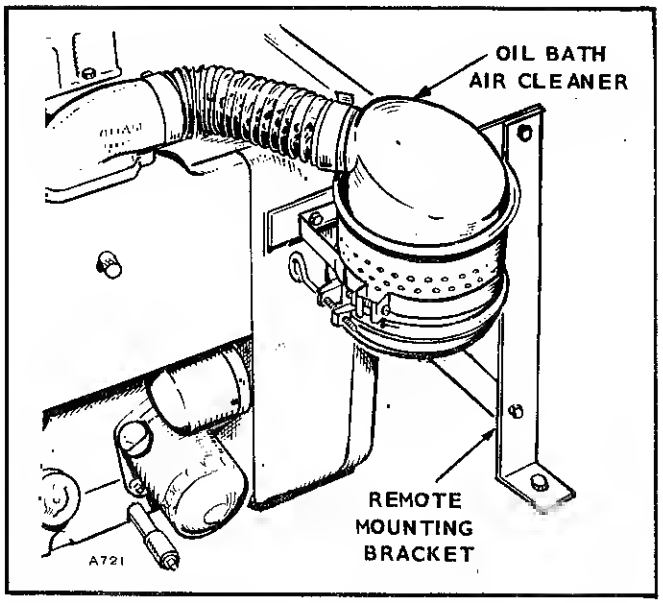


FIGURE 26. OIL BATH AIR CLEANER

Foam Type Cleaner: This cleaner consists of a foam element over a metal retainer. Approximately every 200hrs, remove the foam element and wash it thoroughly in gasoline. Then dip it in crankcase grade oil and squeeze as dry as possible. The element should be replaced only if damaged.

Oil Bath Air Cleaner (Optional) (Fig. 26): Clean and Refill the oil cup at regular intervals, depending on the ambient operating conditions. In aome conditiona, service the cleaner daily. Establish a regular cleaning interval so the operator can correctly service clean the cup before the dirt accumulates in the bottom to a depth of 1/2 in. or the oil appears too heavy to spray or circulate properly. Use same crankcase grade oil. When changing oil, inspect the wire screen filtering element and remove any accumulation of lint, etc. Air

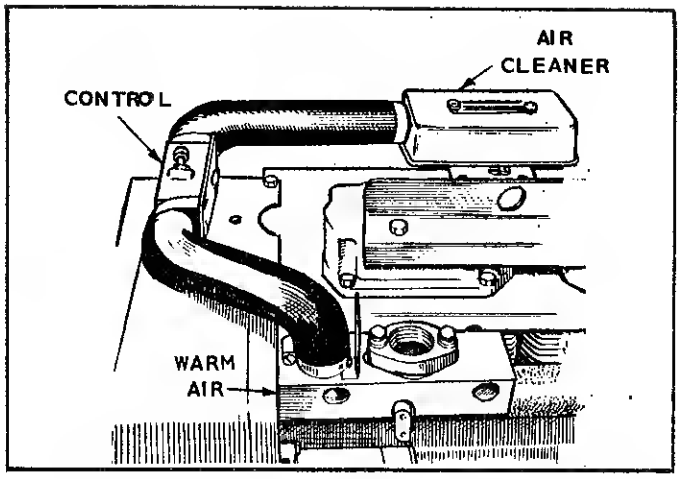


FIGURE 27. CARBURETOR AIR PRE-HEATER

cleaner mounts remotely; flexible hose must have slack.

CARBURETOR AIR PRE-HEATER (Optional) (Fig. 27): Heated air supplied to the air cleaner during cold weather prevents carburetor icing. The air source is automatically selected by the Vernatherm (thermo-static element) which operates a shutter in the induction air stream. The shutter is fully closed at 80°F (just touches bottom), is half open at 90°F, and is fully open to ambient air at 100°F.

Flange of hose adapter (where used) is positioned inside of plenum and one sheet metal screw first mounts shield (where uscd next to vertical exhaust). Check shutter for binding. Tee-nut aligns plunger for binding. Mounting depth of Vernatherm adjusts plunger to just touch shutter at 70°F. Grease pointa of contact.

NOTE: *Gaseous fuels (natural gas) do not require preheated air.*

GOVERNOR SYSTEM

The governor system controls engine speed with and without load. The system consists of a governor cup with steel flyballs on the camshaft; a yoke, shaft, and arm; governor spring and adjusting screw; and linkage to the carburetor.

Variations in engine speed changes the position of the governor cup on its shaft. This change is transmitted by the shaft, arm, and linkage to the carburetor throttle lever. Engine speed is determined by the tension on the governor spring. Sensitivity (speed drop from no load to full load) is con-

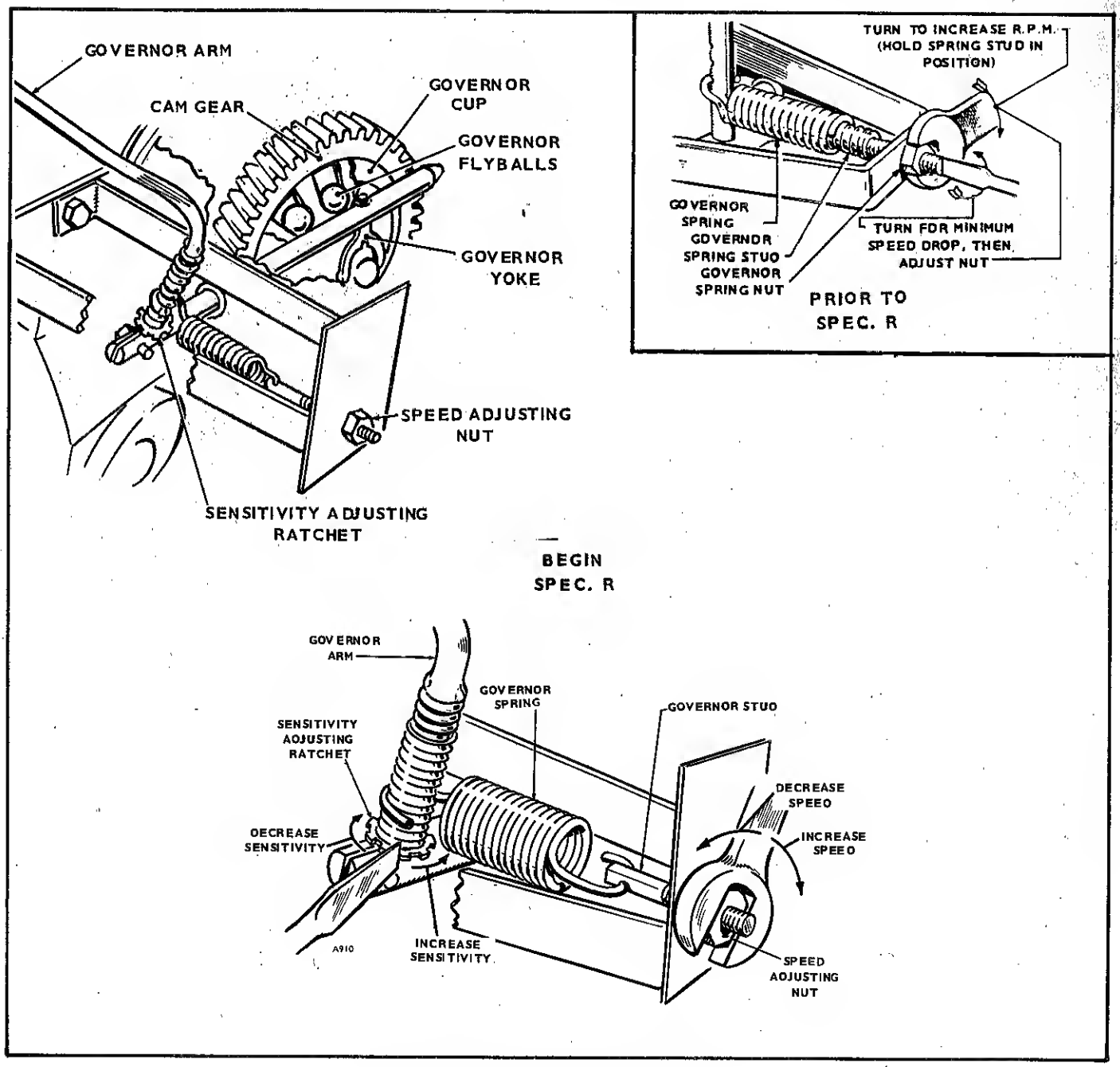


FIGURE 28. GOVERNOR ADJUSTMENTS

trolled by the number of spring coils used. More coils give less speed drop from no load to full load (greater sensitivity).

MAINTENANCE

Periodically lubricate the governor linkage with lubricating graphite or light non-gumming oil. Also, inspect the governor linkage for binding or excessive slack or wear.

ADJUSTMENTS

Prior to Spec R, both the governed speed and the governor sensitivity are adjusted with the stud and nut on the front of the engine air housing (Fig. 28). Beginning Spec. R the sensitivity is adjusted with an adjusting ratchet.

Speed Adjustment (Prior to Spec. R): To adjust the governed speed, hold the governor spring stud in position and turn the governor spring nut with a wrench. For accurate speed adjustment, use a reed type frequency meter on the generator's AC output. A mechanical tachometer can be used, but is not as accurate. Set speed according to Table 2.

Sensitivity Adjustment (Prior to Spec. R): To adjust the sensitivity turn the governor spring stud; counterclockwise gives more sensitivity, (less speed drop). If the governor is too sensitive, a hunting condition occurs (alternate increasing and decreasing speed). Adjust for maximum sensitivity without hunting; see Table 2. After sensitivity adjustment, the speed may require readjustment.

Speed Adjustment (Begin Spec. R): Adjust engine speed (RPM) by turning governor speed adjusting nut (Fig. 28). Turn nut clockwise to increase speed, counterclockwise to decrease speed.

Sensitivity Adjustment (Begin Spec. R): Sensitivity (no-load to full-load speed droop) is adjusted by turning the sensitivity adjusting rachet nut accessible through hole in side of blower housing. If speed drops too much when full load is applied, turn the rachet nut counterclockwise to increase spring tension and compensate for reduced rpm. An oversensitive adjustment, approaching no speed drop when load is applied, may result in hunting condition (alternate increase and decrease in speed).

After adjusting speed and sensitivity, replace dot button in blower housing (air cooled units only) and secure speed stud lock nut.

If the governor is either too sensitive or not sensitive enough and can't be adjusted with the stud or ratchet, the sensitivity can be coarsely adjusted by changing spring attachment on the governor arm. Moving this point further from the governor shaft decreases the governor's sensitivity.

TABLE 2.

Plant Model	Nominal Output Frequency (cps)	Maximum Allowable Frequency (cps)	Minimum Allowable Frequency (cps)	Preferred Frequency Spread -No Load To Full Load
Revolving Armature	60	64 1920	57 (1710)	3 (90)
	50	54 1620	47 (1410)	3 (90)
Revolving Field	60	63 1890	59 (1770)	3 (90)
	50	52 (1560)	48 (1440)	3 (90)

NOTE: Numbers in parentheses are plant speed in rpm.

OIL SYSTEM

J series electric generating plants have pressure lubrication to all working parts of the engine. The oil system includes an oil intake cup, gear type oil pump, by-pass valve, oil pressure gauge, full-flow oil filter, and crankcase passages and drillings to deliver oil throughout the engine. Oil is held in the oil base, drawn by the pump, and delivered through the oil filter. Lines leading to the rocker housing, drillings through the crankcase to the crankshaft bearings and camshaft front bearing, crankshaft passages to connecting rod bearings and connecting rod passages to piston pin bushings complete the oil system plumbing. Because it aids oil consumption control, the crankcase breather is included in this system.

Normal oil pressure should be 25 psi or higher when the engine is at operating temperature. If pressure drops below 20 psi at governed speed, inspect the oil system for faulty components.

MAINTENANCE

Periodic oil system maintenance should include changing crankcase oil, cleaning the crankcase breather, cleaning rocker box oil lines and replacing the oil filter.

Use a good-quality heavy-duty detergent oil that meets the API (American Petroleum Institute) service designations MS, MS/DG, or MS/DM. Recommended SAE oil numbers for

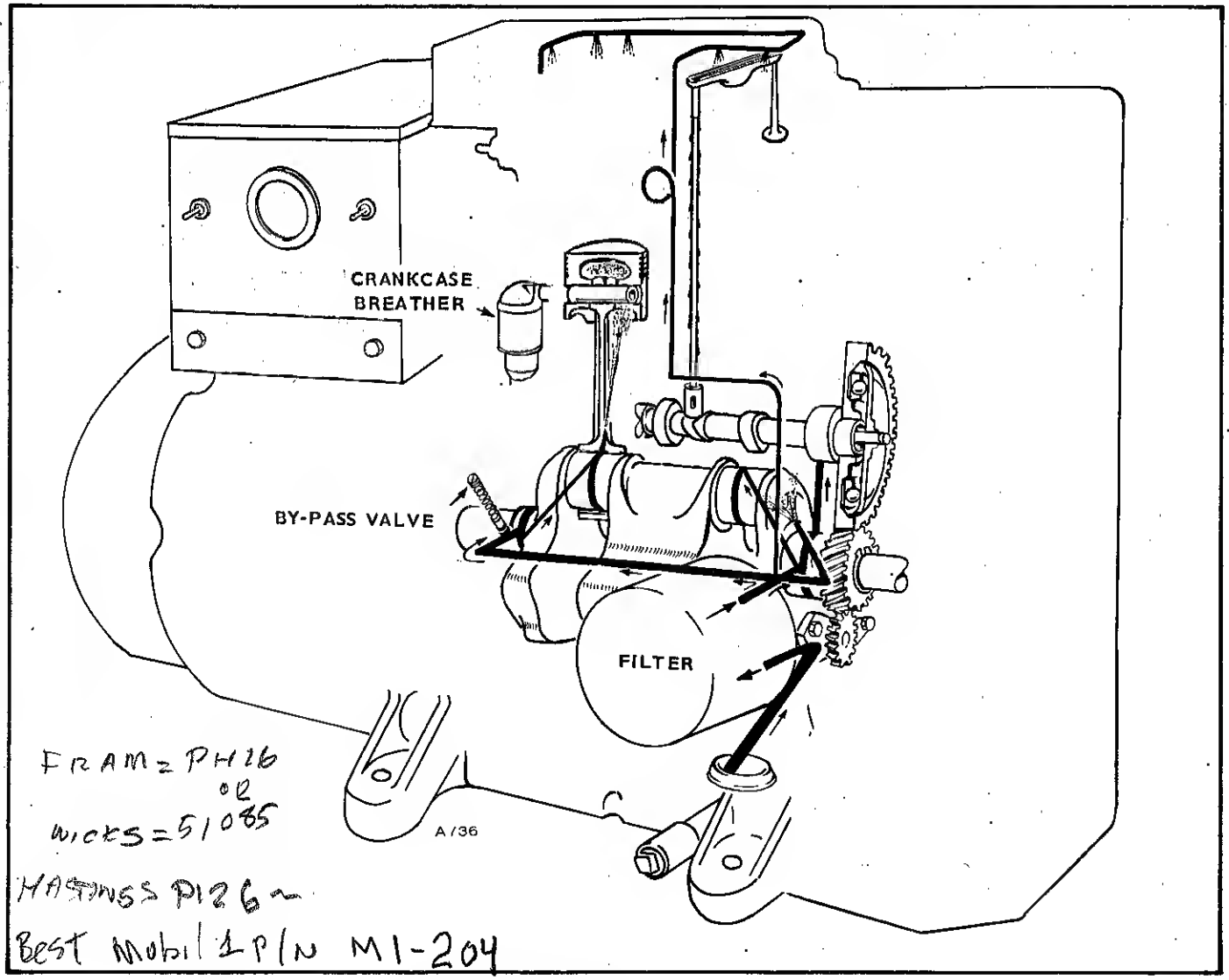


FIGURE 29. OIL SYSTEM

expected ambient temperatures are as follows:

30°F and Above SAE 30
30°F and Below SAE 5W-20 (DO NOT use when ambient above 70°F.

OIL PUMP

The oil pump is mounted on the front of the crankcase behind the gear cover and is driven by the crankshaft gear.

Removal:

1. Remove the gear cover and oil base (Refer to Engine Repair Section). Unscrew the intake cup from the pump.
2. Remove the crankshaft lock ring and gear retaining washer.
3. Loosen the two capscrews holding the pump and remove the pump.

Repair: Except for the gaskets, component parts of the pump are not individually available. If the pump is defective or worn, replace it. Disassemble the pump by removing the two capscrews holding the pump cover to the body. Inspect for excessive wear in gears and shafts. To improve pump performance, adjust the gear end clearance by using the thinnest gasket that permits free movement of the pump shaft. Oil all parts when reassembling the pump.

Installation: Before installing, fill the pump intake and outlet with oil. Mount the pump on the engine and adjust for .005" lash between the pump gear and the crankshaft gear. Mount the intake cup on the pump so it is parallel with the bottom of the crankcase.

BY-PASS VALVE

The by-pass valve (located on the outside of the rear bearing plate) controls oil pressure by allowing excess oil to flow directly back to the crankcase. Normally the valve begins to open about 25 psi. It is non-adjustable and normally needs no maintenance. To determine if abnormal (high or low) oil pressure is caused by a sticking plunger, clean and inspect the valve.

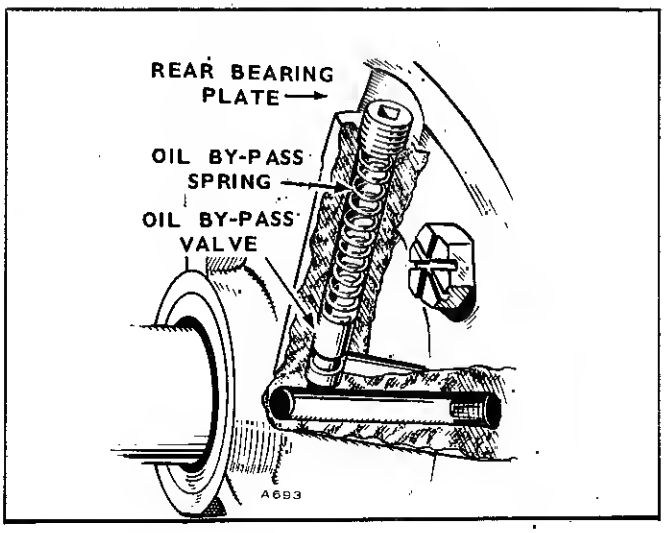


FIGURE 30. OIL BY-PASS VALVE

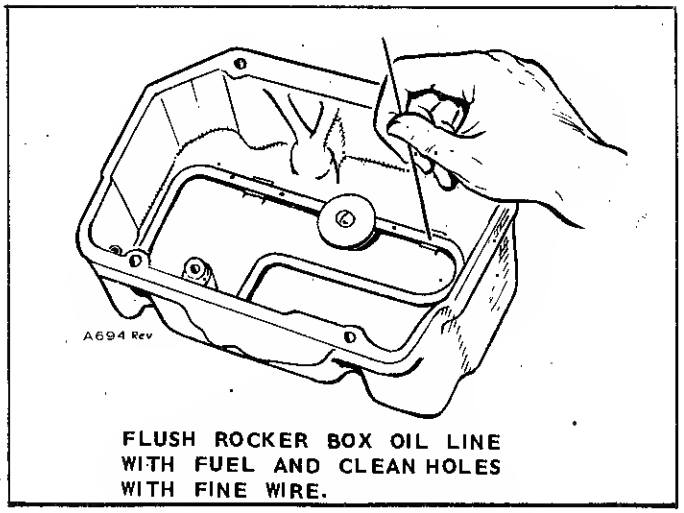


FIGURE 31. ROCKER BOX OIL LINE

To remove the valve, first remove generator assembly (see Generator Repair Section). Unscrew the recessed plug in the rear bearing plate and lift out the spring and plunger assembly (Fig. 30). Determine proper valve operation by checking the spring and plunger according to the following

Plunger Diameter	.3365" to .3380"
Spring	
Free Length	2-5/16" – 1/16"
2.225 lb. ± .11 lb. at	1-3/16"

OIL LINES

The rocker box oil line (Fig. 31) should be flushed with approved solvent and the small holes cleaned with fine wire every 1000 hours. Clean other oil lines and drillings with compressed air whenever the engine is disassembled or overhauled. Remove the oil mounting plate to reach the oil gauge passage.

All external oil lines, the rocker box oil line and the internal oil line to the rear bearing are replaceable.

OIL PRESSURE GAUGE

The gauge is located on the lower front corner of the cylinder block. If it is damaged, replace it. Before replacing, check for a clogged oil passage behind the gauge.

OIL FILTER PER-17

The full-flow filter is mounted on the filter plate at the left front corner of the crankcase. Replacement is normally every 200 hours of operation. Remove the filter by turning counterclockwise. Lubricate the gasket on the new filter with engine oil. Install the filter until the gasket touches the base and tighten 1/2 turn; do not overtighten.

If at any time the oil becomes so dirty that markings on the dipstick can't be seen, change the oil filter and shorten the filter service interval accordingly.

CRANKCASE BREATHER

The crankcase breather, located in the rear left corner of the crankcase maintains a partial vacuum in the crankcase

during operation to control oil loss and ventilate the crankcase. The older type includes a metal filter packed into the tube on the crankcase, a rubber cap with flapper valve, and hose connecting it to the engine air horn.

NOTE: *The JC does not use a flapper valve.*

To disassemble, remove the rubber cap from the crankcase tube and pry the valve out of the cap. Wash the valve in fuel at regular intervals and, if defective, replace it. Also, pull the baffle out of the breather tube and clean it. Install the valve with the perforated disk toward the engine.

Service the breather system at least every 200 hours. See Figure 32.

Beginning with Spec S, the JB uses the new style breather shown in Figure 32. The JC, prior to Spec T, retains the older breather system without the valve.

Beginning with Spec T, the JC uses a PCV (Positive Crankcase Ventilation) valve mounted under the rocker boxes. See Figure 32.

Every 500 hours remove the PCV valve; wash in diesel fuel or kerosene, and inspect for carbon residue. If the valve appears to be unusually gummy, it may have to be disassembled for cleaning. Replacement with a new valve is preferable under these conditions.

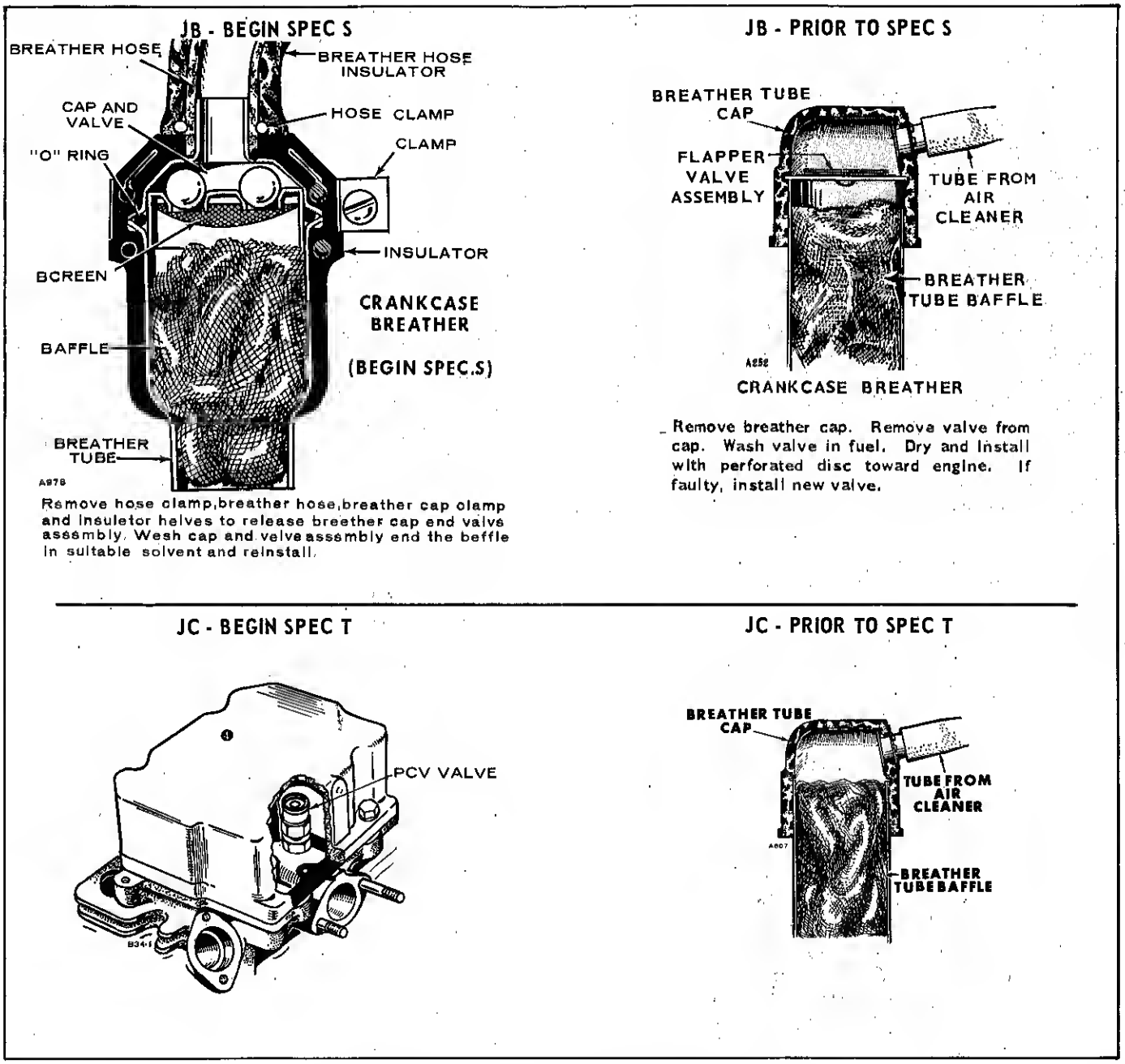


FIGURE 32. CRANKCASE BREATHER SYSTEMS

IGNITION SYSTEM

Three different types of ignition systems cover the manual and remote starting models on 2 and 4-cylinder engines. The manual starting 2-cylinder model (JB-M) uses a magneto system. The 2-cylinder remote and electric starting plants (JB-R, JB-E) use a battery ignition system. The 4-cylinder model (JC) uses a battery ignition system with automotive distributor. For details of specially suppressed systems (not covered here), request suppression drawing.

TESTING

Remove each plug, install the ignition wire to each plug and hold the plug base against bare engine metal. Crank the engine and watch the spark. A good blue spark indicates a healthy ignition system, a weak or yellow spark or no spark, a poor ignition system. The defect can be caused by defective breaker points, coil, condenser, or wiring. A good spark on all but 1-cylinder indicates a defective spark plug or defective high tension wire.

BATTERY IGNITION (JB Electric and Remote starting Plants)

This model (Fig. 33) uses a single coil, battery ignition to fire both spark plugs simultaneously; one spark plug fires on the exhaust stroke while the other is firing at the end of the compression stroke. A spark advance on the breaker point mechanism advances the spark from 5° ATC (after top center) when cranked to 25° BTC (before top center) when running at rated speed.

EXCEPTION: *Advance 10° more for gas fuel!*

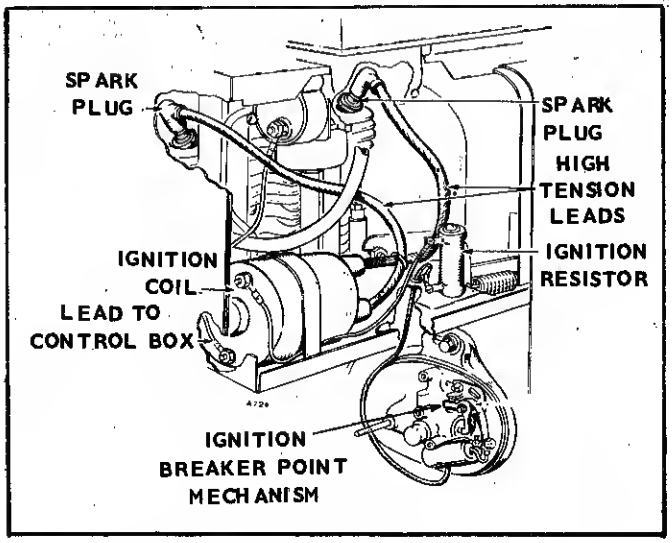


FIGURE 33. BATTERY IGNITION (JB)

Maintenance: Periodic maintenance should include –

1. Checking the ignition breaker point gap.
2. Checking and cleaning spark plugs.
3. Inspecting both the low and hi tension wiring.
4. Checking the ignition timing.

To adjust the breaker gap, rotate the crankshaft clockwise until the 55° ATC mark on the flywheel matches the timing pointer (Fig. 34).

Check gap with a feeler gauge for .020 in. Adjust the gap by loosening the adjustment screw and moving the stationary contact. Tighten the screw and check the gap (Fig. 35). Check the points for cleanliness and pitting. Clean the points with paper or gauze tape. If they are dofective or excessivoly pitted, replace them.

NOTE: *Some early plants had no 55° ATC mark on the flywheel. On these models, open the breaker box and rotate the flywheel until the breaker points reach maximum gap.*

Timing 2-Cylinder: The engine can be timed either stopped or running at rated speed. With the engine stopped, timing should be set for ignition at 5° ATC; with the engine running at rated speed, 25° BTC. Adjust the breaker point gap before timing the ignition.

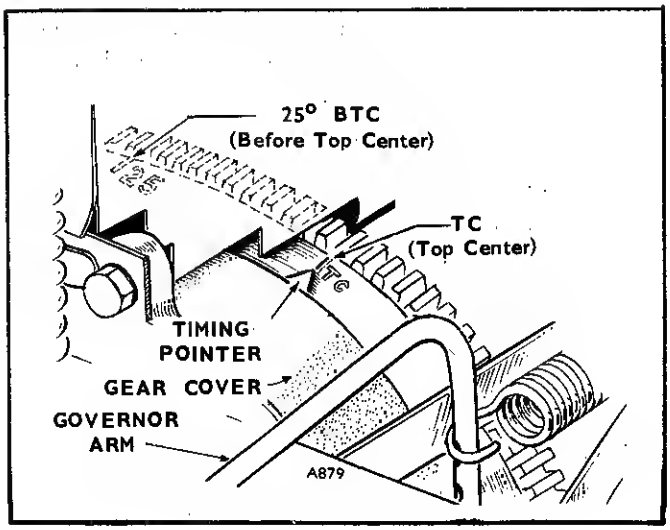


FIGURE 34. TIMING MARK

Timing Pracedure, Plant Stopped:

1. Remove the access door in the air housing. Remove the breaker points' cover, disconnect the lead to the ignition points and install a continuity test lamp and battery so the lamp lights when the points are closed.

2. Rotate the flywheel clockwise until the TC mark on the flywheel approaches the timing indicator (Fig. 34). Then slowly rotate the flywheel clockwise until the light goes out indicating that the points have opened. This is the ignition point. If timing is correct, ignition will occur at 5° ATC.

3. If ignition timing isn't correct, align the 5° ATC mark and the timing pointer, then loosen the breaker plate capscrews and rotate the plate so the light goes out. Rotating clockwise advances timing, counterclockwise retards it (Fig. 35).

4. Tighten the plate and check timing, step 2. If timing isn' t correct, readjust the plate. Otherwise connect the ignition lead and install the cover.

Timing Procedure, Plant Running:

1. Remove the access door and install an automotive timing light on either of the spark plug leads.

2. Run the engine at rated speed and check timing with the light. If timing ia incorrect, loosen the breaker plate mounting screws and correct it by rotating the plate. Rotating clockwise advances timing, counter clockwise retards it. Tighten the plate and recheck the timing point. See Figure 35.

CAUTION: *With the access door open, the engine will overheat rapidly. Run it only a few minutes and only without load.*

3. Adjust the timing, tighten the breaker plate and then recheck the ignition point gap.

If the breaker points can't be adjusted to specifications, either the timing gear or camshaft gear is incorrectly installed or the centrifugal advance mechanism is defective. Disassemble the breaker mechanism for repair.

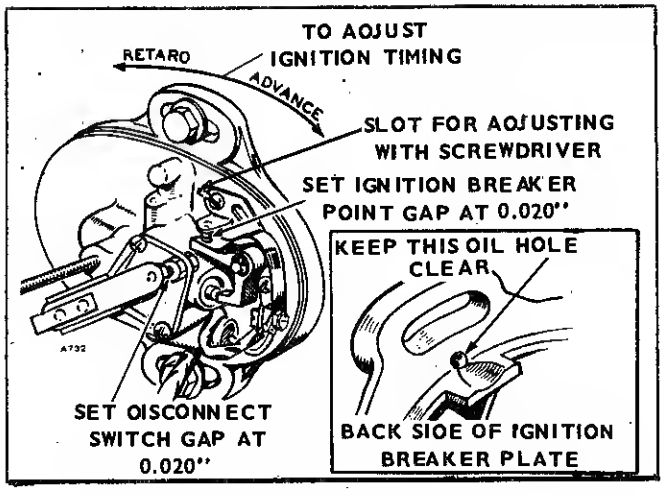


FIGURE 35. AOJUSTING IGNITION TIMING

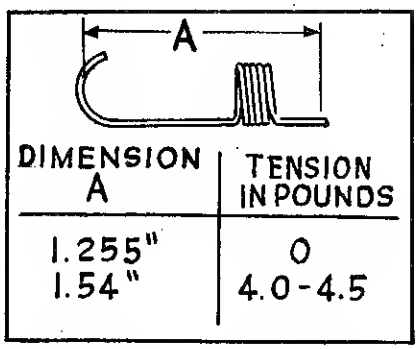


FIGURE 36. SPRING TENSION

Breoker Points: The breaker points operate from a cam located on the timing or start-disconnect gear. This gear is driven by the camshaft gear.

Disassembly

1. Disconnect the battery to prevent accidental shorts.

2. Remove the point set cover and disconnect the wires from the start-disconnect switch (if used) and the Ignition breaker points.

3. Remove the two capscrewa holding the breaker plate assembly and pull off the plate.

4. Pull out the cam and weight assembly. Be careful not to lose the spacer mounted on the gear shaft.

5. To disassemble the breaker plate assembly, remove the condenser and points and pull out the plunger and plunger diaphragm.

Repair: Thoroughly clean the gear and cam assembly. The weights should move freely in and out without catching in either end position. Inspect the gear ramp for notches or other defects. If any part of the cam, weight and gear assembly sticks, replace the complete assembly. Inspect the weight springs, and compare them with Fig. 36. If the cam is loose on the gear shaft, replace the complete assembly. Clean and inspect the bearing surfaces in the breaker plate and gea r case; clean the oil trickle holes into these bearings. Check the oil spray hole in the gear case to be sure it is open. If the breaker points won't maintain the proper gap, check for excess wear in both the cam and the ignition breaker plunger.

Assembly:

1. Install springs on the weight assemblies. Install the cam on the gear shaft, being sure to align the timing marks, (Fig. 37) and install the cam spring. Weights should snap outward between 1000 and 1075 rpm. If necessary, adjust by lightly bending one or both spring anchor pins toward center of gear.

2. Install the spacer and thrust washer on the gear shaft assembly, and install the assembly into the gearcase, matching the timing marks on the timing gear and camshaft gear (Fig. 37).

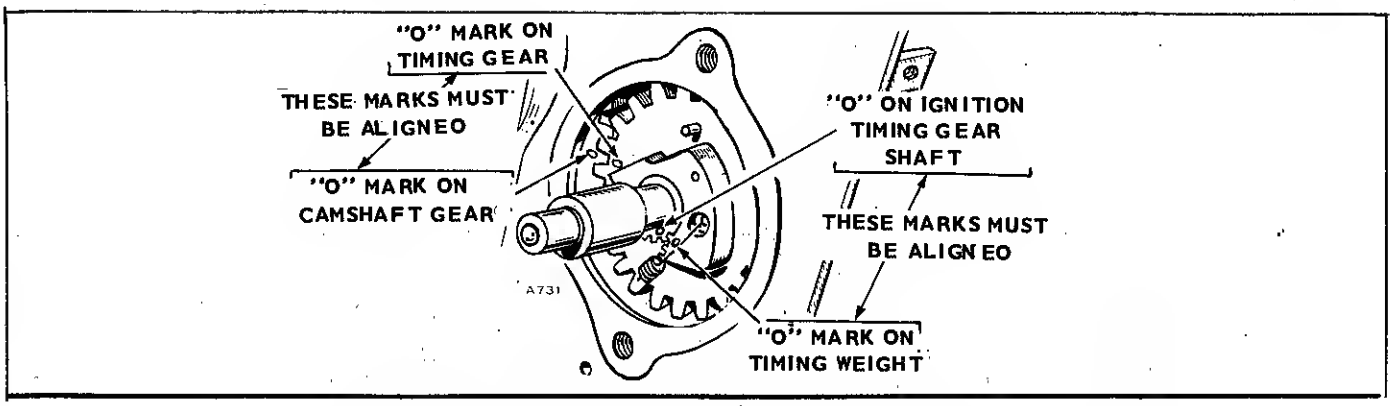


FIGURE 37. TIMING GEAR MARKS

3. Install the spring and plunger on the end of the shaft.

4. Install the breaker plate. Install the ignition plunger and diaphragm and diagram cup (Fig. 38).

5. Install the start-disconnect (when used) diaphragm and plunger, and install the start-disconnect breaker points.

6. Adjust the start-disconnect breaker point gap to .020".

7. Install the ignition breaker points and adjust the gap. Time the ignition.

Condenser: The .3 mfd condenser mounted on the breaker plate aids primary field breakdown when the points open and prolongs the life of the breaker points by reducing the arc across them. A defective condenser causes a weak spark and rapid breaker point wear. Use a standard commercial condenser checker to test the condenser for leakage, openings or grounding. If no tester is available, check for shorts or defective leads and replace the condenser if you suspect it of defects.

Coil: If spark is weak or there is no spark, and the breaker points are clean and properly adjusted, test the coil for possible defects. Disconnect both spark plug leads, ground one and hold the other about 3/8" from the engine. Crank the engine. If there is a good spark the coil is operating. Also test the coil as follows:

1. Disconnect the breaker point lead at the breaker points and measure resistance from that lead to ground. It should be about 1 ohm.

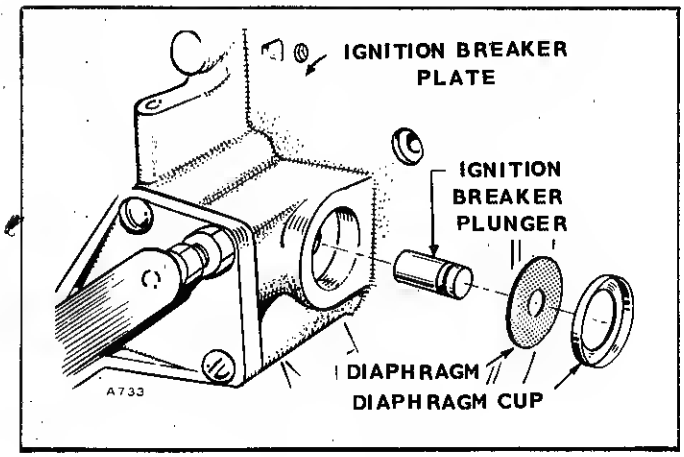


FIGURE 38. DIAPHRAGM & CUP

2. Disconnect both spark plug leads at the plugs and measure resistance between them. Resistance should be between 7000 and 10,000-ohms. If it is higher, either the high tension terminals or spark plug leads are defective. Remove the leads and check resistance of the coil between the hi-tension terminals. Check the terminals for corrosion. Check the leads for resistance; replace any that show a high resistance. If resistance is low, the coil is probably shorted and should be replaced.

3. Check for shorting between the primary and secondary coils by checking for continuity between a primary terminal and secondary terminal.

IMPORTANT: *Test this coil using a six volt tester only.*

MAGNETO IGNITION (JB Manual Start)

This ignition system is similar to the JB battery ignition except that it uses a magneto as a source of power. The magneto is behind the flywheel and consists of both stator and secondary windings, energized by permanent magnets on the flywheel.

For maintenance, timing, condenser repair, and for breaker repair, refer to the applicable section in battery ignition.

Magneto Coil: The magneto coil is located behind the engine flywheel and reached by removing the flywheel. If ignition spark at the spark plugs is defective, first inspect the breaker points. To test the coil, remove both spark plug leads; ground one to bare engine metal. Hold the other about 3/8" away from bare metal and crank the engine; a good spark should occur between the lead and engine. If not, the coil, flywheel magnets, or high tension leads are defective. Test the coil as follows:

1. With an ohmmeter, check resistance between the lead to the breaker points (disconnected from the points) and a good ground on the engine. Resistance should be about 0.6-ohms.

2. Remove both spark plug leads from the plugs and measure resistance between the leads. Resistance should be

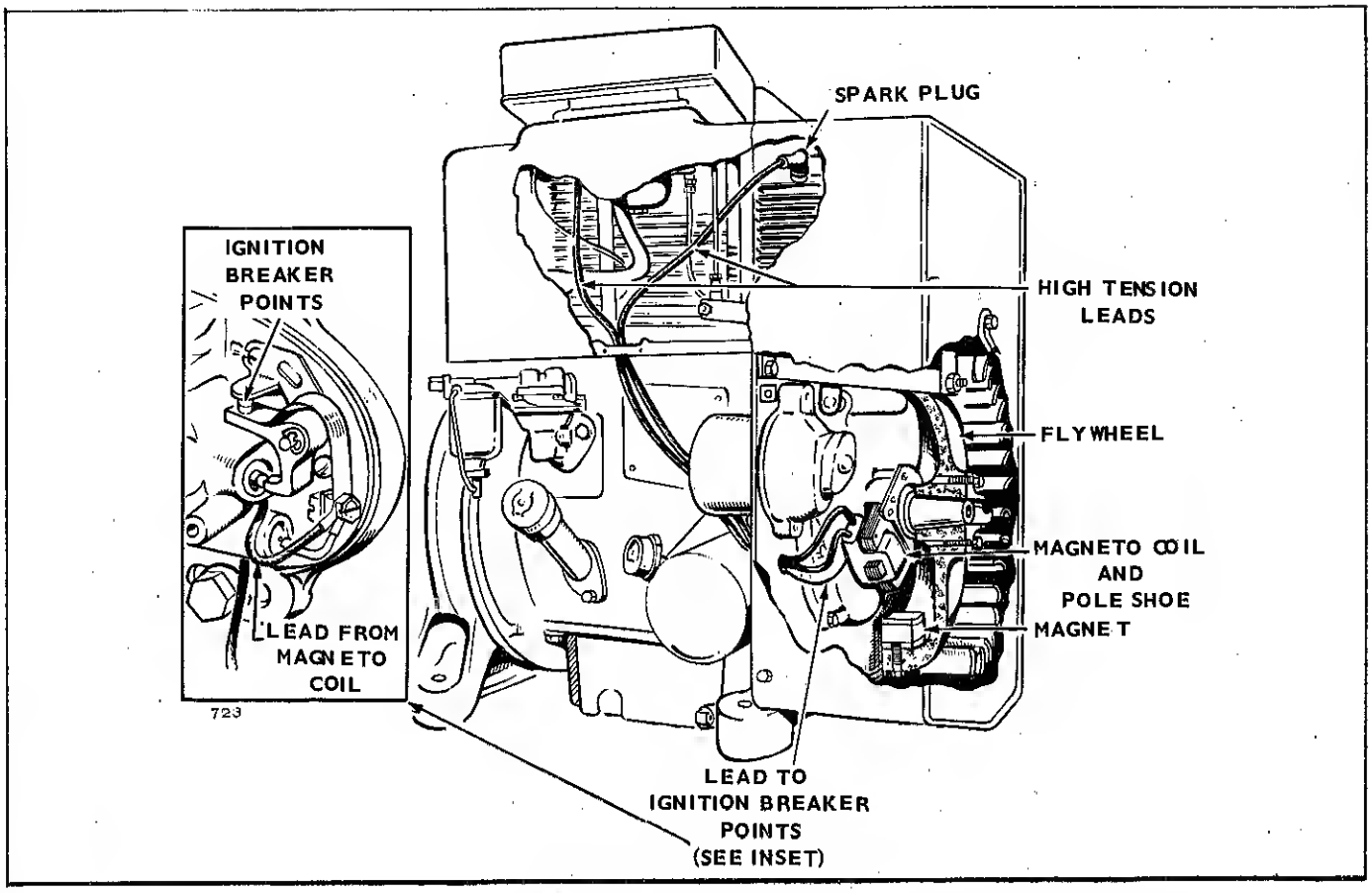


FIGURE 39. MAGNETO IGNITION

about 11,000-ohms. If it is greater, either the leads or magneto high tension coils contain a high resistance or are open circuited. The magneto should be removed to test resiatances of the coil and leads separately. Inspect the high tension terminals on the coil for corrosion. If the resistance is low, the secondary winding is probably shorted and the coil must be replaced.

3. Check for shorting between the primary and secondary circuits by measuring resistance from the breaker lead to a spark plug lead. Any continuity indicates a defective coil.

Flywheel Magnets: Permanent magnets mounted on the flywheel provide a magnetic field for the magneto coils. Never remove these magnets from the flywheel, it may destroy their alignment and seriously weaken the magnets.

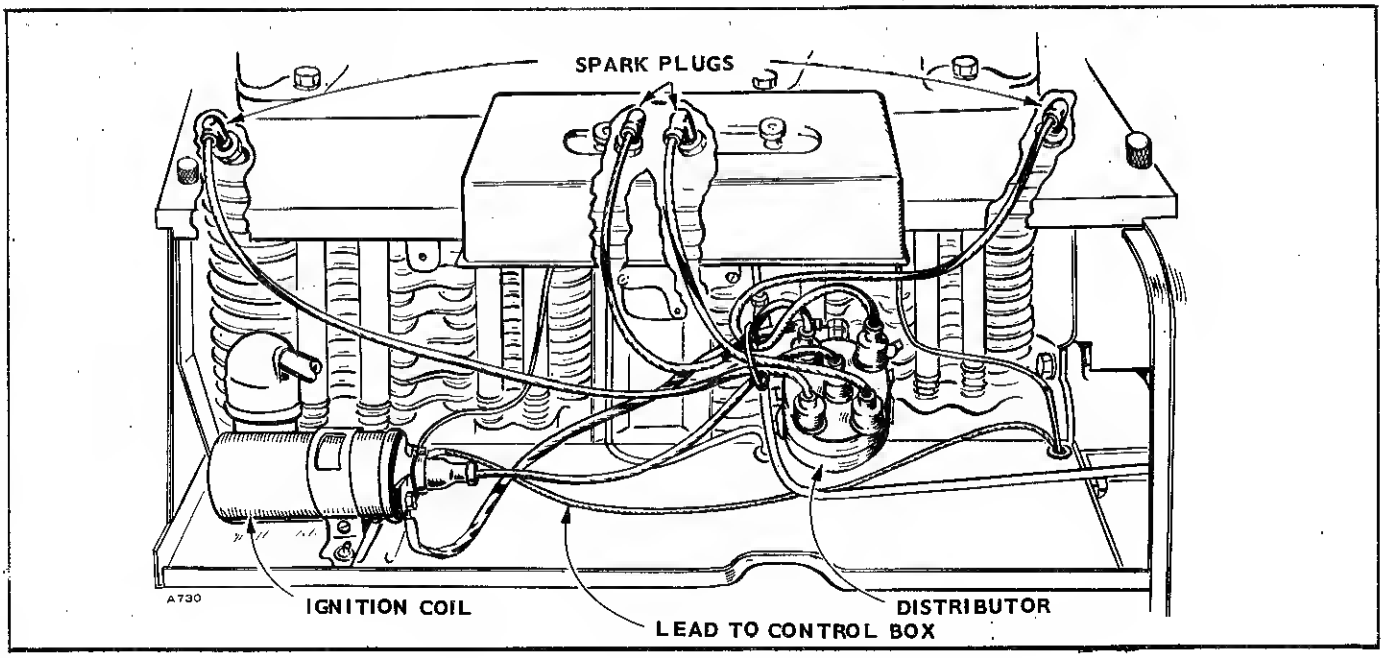


FIGURE 40. JC IGNITION SYSTEM

A piece of steel held on the magnets must be strongly attracted to the magnets.

The magnets shouldn't loose strength with age or be affected by dropping the flywheel. If the magnetism is lost, return the flywheel to the factory for recharging. Some flywheel magnet chargers in the field can recharge the magnets, but makeshift equipment will probably reduce the magnetism further. To recharge the magnet it must have the correct polarity. The north seeking end of a compass needle must be attracted toward the leading magnet pole.

JC IGNITION SYSTEM

The JC electric plant uses a battery ignition system with automotive distributor to produce and distribute spark, (Fig. 40).

The system includes ignition coil, distributor with spark advance and breaker points, and spark plugs.

Maintenance: Periodic maintenance of the system should include oiling the distributor, cleaning and adjusting the breaker points, checking ignition timing, cleaning and adjusting the spark plugs, and general inspection of the ignition system wiring.

At regular intervals, add 3 to 5 drops of medium engine oil to the oiler on the distributor. Add 1 drop of light engine oil to the breaker arm hinge pin and 3 to 5 drops to the felt in the top of the breaker cam and to the governor weight pivots. Wipe grease lightly on each lobe of the breaker arm. Don't over lubricate the distributor.

To adjust the breaker points, remove the distributor cap and rotor. Rotate the crankshaft to get maximum breaker gap. The gap should be between .018 in. and .022 in. At the same time, inspect the points for dirt or pitting. Dirty points can be cleaned with tape and carbon tetrachloride. But if the points are excessively pitted, they must be replaced.

Check the distributor cap for cracks, carbon runners, corroded high tension terminals or excessively burned inserts.

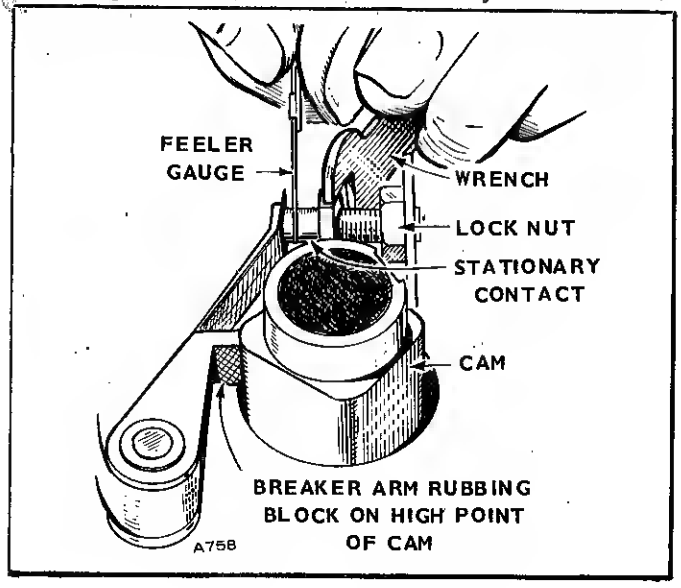


FIGURE 41. POINT ADJUSTMENT

After normal use, the vertical surfaces of the cap inserts become slightly burned. They can be cleaned with carbon tetrachloride; but don't file the inserts. If vertical or horizontal faces of inserts are burned, replace the distributor cap. Inspect the rotor for cracks or for burning on the top of the metal strip. If the vertical surface is slightly burned, clean it with carbon tetrachloride. But if the top is burned, replace the rotor.

Timing: The JC ignition system may be timed either with the engine stopped or running. But before timing the ignition, be sure the breaker points are clean and properly adjusted. Set the timing at 25° BTC of each compression stroke.

EXCEPTION: *Advance 10° more for gas fuel!*

Timing Procedure, Engine Stopped:

1. Disconnect the low voltage lead to the distributor and connect a test lamp and battery so the lamp lights when the breaker points are closed.

2. Remove the spark plug from #1 cylinder and rotate the flywheel clockwise until air is forced out of the spark plug hole.

3. Continue rotating the flywheel slowly until the test lamp goes out, indicating that the breaker points have opened. If the TC mark on the flywheel and the ignition timing pointer are aligned, timing is correct, otherwise adjust the distributor.

4. To adjust timing, align the flywheel TC mark and the timing pointer. Loosen the distributor body and rotate it (clockwise if ignition occured early and counterclockwise if late), until the light goes out. Tighten the distributor body in the new position and check the timing, step 3. If timing still doesn't occur at the correct point, repeat step 4.

Timing, Engine Running:

1. Remove the access door and install an automotive timing light on the spark plug for cylinder #1. Run the plant at rated speed. Aim the flashing timing light in through the access door opening and toward the flywheel.

CAUTION *Don't run the engine for more than a minute or two with the access door removed. The engine overheats rapidly and could damage itself. Run without load.*

2. The timing pointer on the gear cover must indicate 25° BTC. To adjust timing, loosen the distributor body clamp and rotate the distributor body. If timing is early (25° mark to the right of the pointer) rotate the distributor clockwise to retard the ignition point. Tighten the distributor in its mount and recheck timing.

NOTE: *If the relative position of the timing marks doesn't remain steady, the distributor may be defective. This can be caused by pitted or misaligned breaker*

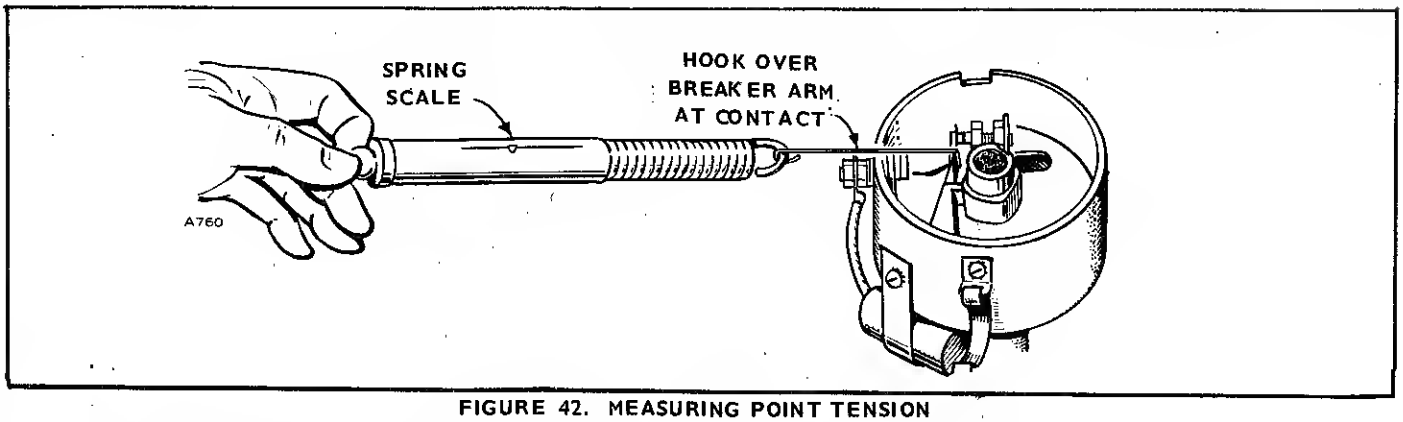


FIGURE 42. MEASURING POINT TENSION

points, incorrect breaker point spring tension, worn or loose breaker plate or a worn distributor shaft or bushing.

Distributor: The distributor contains and opens the breaker points at the proper time, contains an automatic spark advance mechanism, and distributes the spark to the proper cylinder.

Testing: Remove the distributor and test it on a commercial tester. Following the equipment manufacturer's instructions, check the centrifugal advance mechanism and cam dwell angle. The cam dwell angle should be 51 $\pm$ 3°. Do not set breaker gap by cam dwell. With the proper point gap, if cam dwell is outside the above limits, check for worn distributor cam.

If a distributor tester isn't available, test as follows:

To check the spark advance mechanism, remove the distributor cap and rotate the rotor several degrees clockwise. If the advance mechanism is operating properly, the rotor will return to its original position. If not, overhaul the distributor.

Thoroughly inspect the breaker points and check to be sure the movable contact turns freely on its pivot.

Using a spring scale (Fig. 42), measure the tension of the points as they break contact. Tension should be 17 to 20 ounces. If it is greater, it causes excess wear; if less it causes contact bounce. To adjust tension, refer to Distributor Assembly.

Removal and Disassembly:

1. Remove the distributor cap by releasing the clips on the distributor. Remove the primary lead from the distributor terminal.

2. Record the distributor body position and the rotor position for easier assembly.

3. Remove the distributor hold-down capscrew and pull the distributor out of the crankcase.

4. Remove the 3 screws holding the breaker plate to the distributor housing and loosen the primary lead mounting terminal. Lift the breaker arm off its hinge.

5. Rotate the breaker plate counterclockwise about 45° and pull it out of the distributor body. Remove the two centrifugal advance springs.

6. Remove the spring clip (cam retaining spring) holding the cam to the drive shaft and lift out the cam. The weights are now free and can be lifted out.

7. To remove the drive shaft, grind or file off the peened-over end of the pin holding the drive gear to the shaft. Drive out the pin, then remove the gear and pull the shaft out through the distributor body.

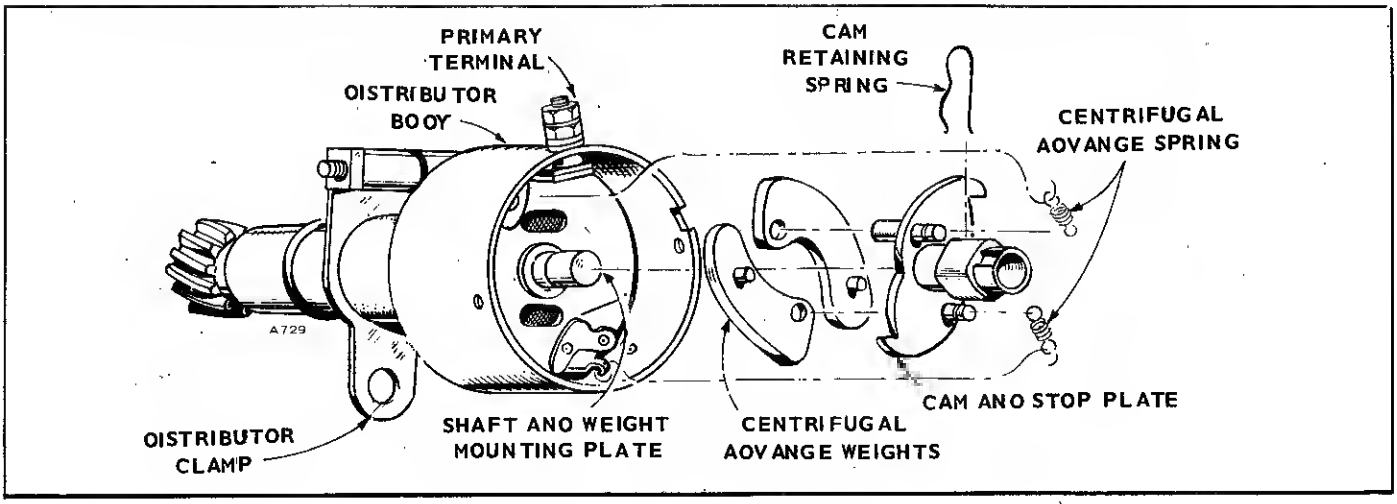


FIGURE 43. JC DISTRIBUTOR DISASSEMBLY

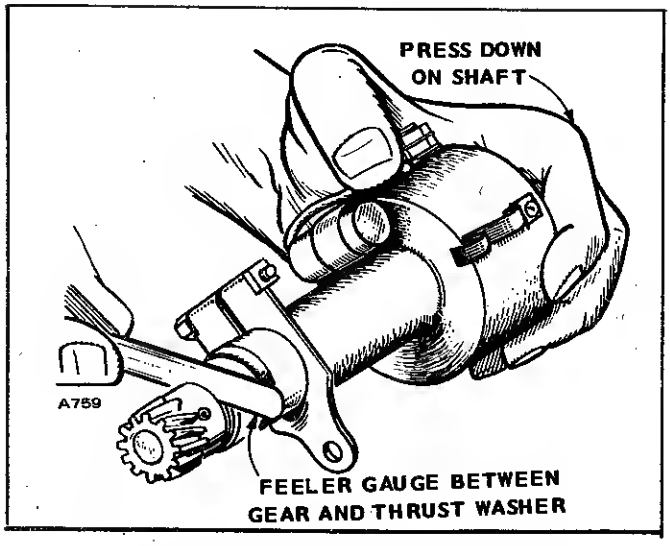


FIGURE 44. CHECKING END PLAY

8. If necessary, press the two bronze bearings out of the distributor body.

Repair: Clean all components except the condenser, breaker points and bushings in light cleaning solvent. Inspect the centrifugal advance component for signs of wear and replace any that appear worn or otherwise damaged. Inspect the cam and shaft for wear or score marks. If either is scored, replace it.

To check bearing wear, set the drive shaft into the body and measure the side play at the top of the cam with a dial indicator. Mount the indicator on the distributor body, and measure the side play by pulling the shaft directly away from the indicator with a force of about 5 pounds. Side play should be less than .005". If not, the bearings must be replaced ONAN doesn't recommend field replacement of bronze shaft bearings unless the required equipment is available. This can be done by an Authorized service station.

Assembly, Distributor:

1. Install the shaft assembly with the upper drive shaft thrust washer in the distributor body. Install the lower drive shaft thrust washer and drive gear. Install a pin through the drive gear and shaft and peen it into place.

2. Check the drive shaft end play (Fig. 44). It should be between .003" and .010". If end play is too small, tap the lower end of the distributor drive shaft lightly with a soft hammer to increase play. If it is too great, check the thrust washer installation or re-install the gear.

3. Set the centrifugal advance weights into place and install the cam. Be sure the pivots on the cam fit into the hole in each weight. Secure the cam with the spring clip and install the weight springs.

4. Install and secure the breaker plate.

5. Mount the breaker arm on its pivot and place the control spring end between the end of the terminal stud and the square metal washer. Then tighten the primary terminal.

6. Align the contacts so they make contact at the center. Bend the stationary contact bracket, not the breaker arm to align contacts.

7. Check the tension of the breaker spring with a spring scale hooked on the arm at the contact and held at right angles to the contact surfaces (Fig. 42). Tension should be 17 to 20 oz. Adjust it by loosening the screw holding the end of the contact spring and installing spacing washers or sliding the end of the spring in or out.

8. Rotate the drive shaft to obtain maximum breaker gap and set the gap for .020" (Fig. 41).

Installation, Distributor: Install the distributor in exactly the same position before removal. When setting the distributor into position, the rotor should be 1/8 turn counterclockwise from the position when removed to allow the gears to mesh. After installing, perform the following steps 4, 5, and 6.

If the exact position of both distributor body and rotor weren't recorded or the crankshaft was rotated, use the following procedure.

1. Remove the spark plug from #1 cylinder. Place a finger over the spark plug hole and rotate the flywheel clockwise until the cylinder builds up pressure. Continue rotating until the TC mark of the flywheel aligns with the timing pointer.

2. Install the rotor on the distributor shaft and the "O" ring on the body.

3. While holding the distributor in the position shown in Fig. 45 and the rotor 1/8 turn counterclockwise from the position shown, push the distributor into its mount-

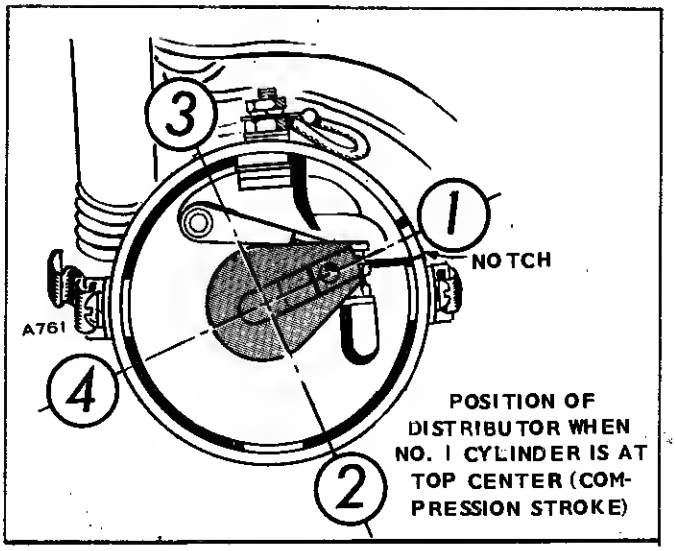


FIGURE 45. DISTRIBUTOR POSITION AT TOP CENTER

ing hole. If necessary, turn the rotor slightly to align teeth of gear. If the rotor is not in the position shown, repeat the procedure changing the gear alignment.

4. Install the distributor clamp screw. If the spark plug leads were removed from the distributor cap, reinstall them in the proper order, see Fig. 40. Time the ignition system.

Ignition Coil: The JC plant uses a standard automotive ignition coil mounted on the air shroud near the engine access door. Inspect and tighten the primary terminals. Inspect the secondary terminal and clean it if necessary.

Test the coil either on a standard automotive tester or by checking primary and secondary winding resistances. Resistance from the high tension terminal to the ground (–) terminal should be 7,000 to 10,000-ohms; resistance between the primary terminals, about 1-ohm.

A quick coil check can be made by simply disconnecting the high tension lead between coil and distributor at the distributor, holding the end about 1/4" from bare engine metal and cranking the engine. A spark between the lead and engine indicates the coil is operating, although it might be weak. No spark indicates that the coil, points, or control circuit to the coil are defective. Check for voltage between the coil negative (–) terminal and ground while cranking the plant and inspect the breaker points.

Ignition Condenser: The condenser is mounted on the outside side of the distributor. Refer to JB Battery Ignition Section for test procedure. Capacitance should be .25 to .28 mfd.

SPARK PLUGS

JB and JC generating plants use standard automotive spark plugs, Champion H-8 or equivalent. Clean and inspect the plugs at regular intervals. Clean on a commercial plug cleaner and gap. For gasoline operation, the spark plug gap should be set at .025". When spark plug electrodes become worn or if the plugs are damaged, replace them. When installing spark plugs always use new gaskets.

NOTE: Periodic check of engine timing is necessary to insure optimum performance.

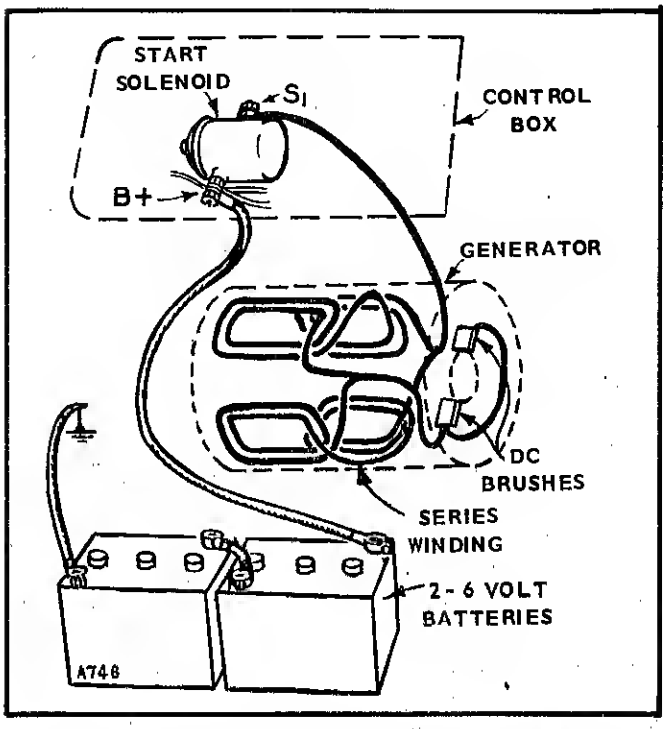


FIGURE 46. REVOLVING ARMATURE STARTING

ONAN electric generating plants use one of two types of starting systems. Plants with revolving armature generators use the generator as a starting motor (Fig. 46). The battery supplies the starting current through a series field winding and the DC section of the armature. A start solenoid in the control box controls starting.

Revolving field generators use a separate starting motor (Fig. 47). The starting motor mounts on the right side of the engine and drives the flywheel for starting. It is a standard automotive starting motor with solenoid shift and over-running clutch, controlled by a start solenoid in the control box. When the control box solenoid energizes, the solenoid on the motor operates, shifting the starter pinion to engage the flywheel ring gear and closing the circuit to the starting motor. The starting motor remains engaged until after the engine starts when the control circuit centrifugal switch closes, completing the starting cycle. The over-running clutch protects the starter armature from overspeeds.

NOTE: *ONAN doesn't stock parts for the starting motor. See an authorized dealer.*

MAINTENANCE

Revolving Armature Models: Poor starter performance may damage the generator. If the starter wouldn't crank over the engine compression stroke, high currents passing through the armature may burn out the commutator. The battery, cables, and generator must be in good operating condition.

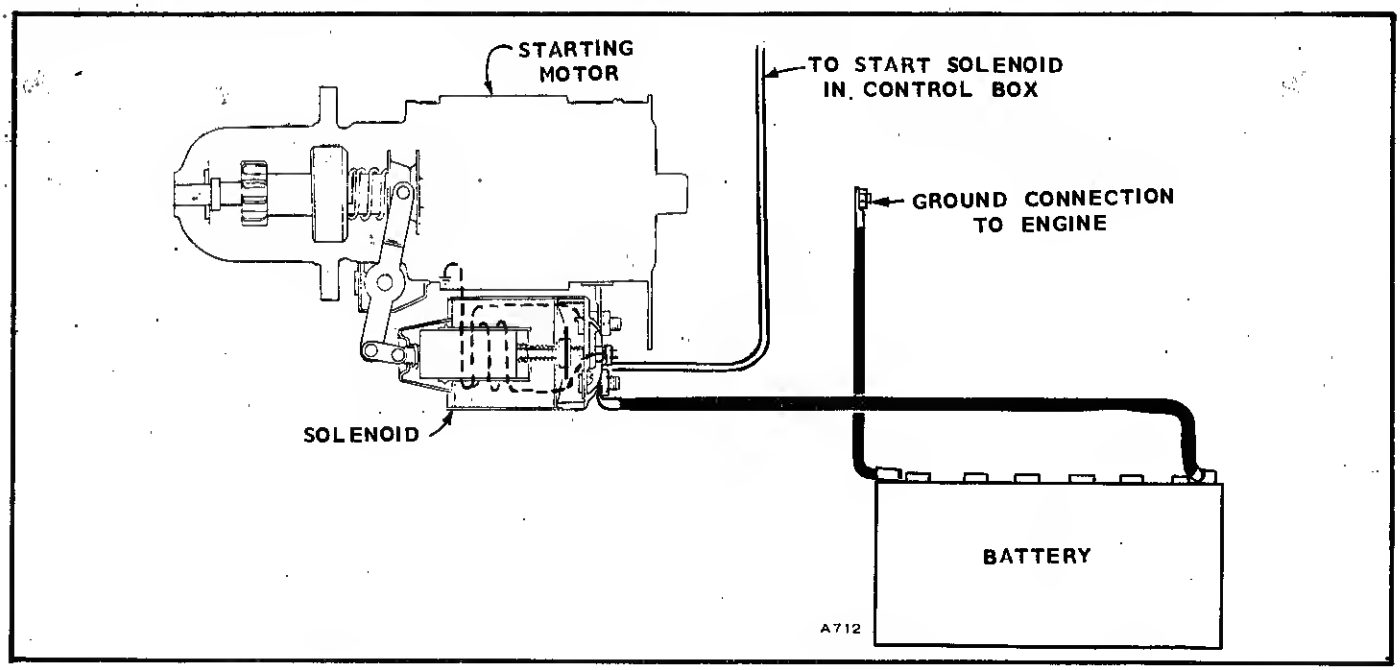


FIGURE 47. STARTING SYSTEM (REVOLVING FIELD GENERATORS)

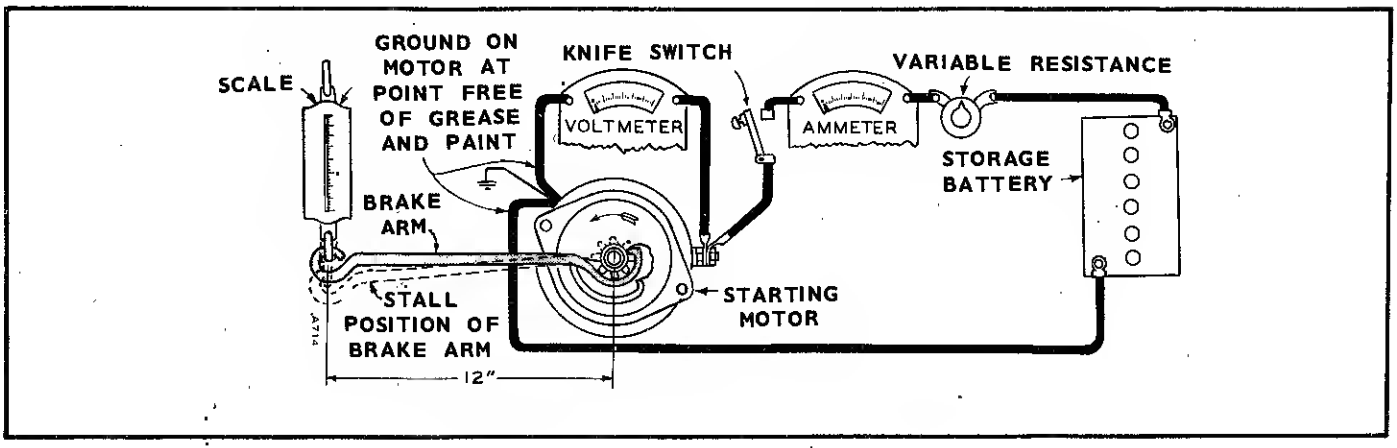


FIGURE 48. STARTER TORQUE TEST

Check the battery water level and charge condition about every 100 hours. Every 500 hours inspect all starting system wiring for loose or dirty connections, especially connections to the battery terminals. Inspect the generator, commutator and brushes for wear, scoring or dirt. For repair instructions refer to Generator Repairs.

Separate Starting Motor: Every 500 hours check for loose or dirty connections. Check the battery water level and charge condition every 100 hours. Inspect the starter commutator and if it is dirty, clean with #00 sandpaper. Check the brushes for excessive wear and reduced seating on the armature.

TESTING

Poor cranking performance can be caused by a faulty starting motor, defective battery or high resistance in the starting circuit.

Battery: Check battery condition with a hydrometer. Specific gravity should be between 1.290 and 1.225. If not, recharge the battery. If the battery won't recharge, replace it.

Wiring: With the starting motor operating, check the voltage drops (1) from the battery ground terminal post (not the cable clamp) to the cylinder block (2) from the cylinder block to the starting motor frame and (3) from the battery positive post to the battery terminal stud on the solenoid. Each drop should be less than 0.2 volts. If extra long battery cables are used, slightly higher voltage drops may result. Thoroughly clean all connections in any part of the circuit showing excessively high voltage drops.

Starting Motor: If starting motor tests are required, remove the motor from the plant. Complete starting motor tests should include both tests of free running voltage, speed and current and tests of stall torque, voltage and current.

To test the free running characteristics, connect the starting motor in series with a battery and ammeter and install a tachometer on the motor. Read the free running current and

CONDITION	CHECK FOR
Low Free Speed, High Current	Tight, dirty or worn bearings, bent armature shaft or loose field power screws which would allow the armature to drag, a shorted armature or a grounded armature or field.
Won't Operate , High Current	Direct ground in switch terminal, field, or frozen shaft bearings.
Won't Operate, No Current	Open field circuit, open armature coils, broken or weakened brush springs, worn brushes, high mica on commutator.
Low Free Speed, Low Torque, Low Current	Open field winding, or high internal resistance due to poor connections, defective leads, or dirty commutator.
High Free Speed, Low Torque, High Current	Shorted field windings. Since there is no easy way to detect shorted field coils because of their low resistance, replace them and check for improved performance.

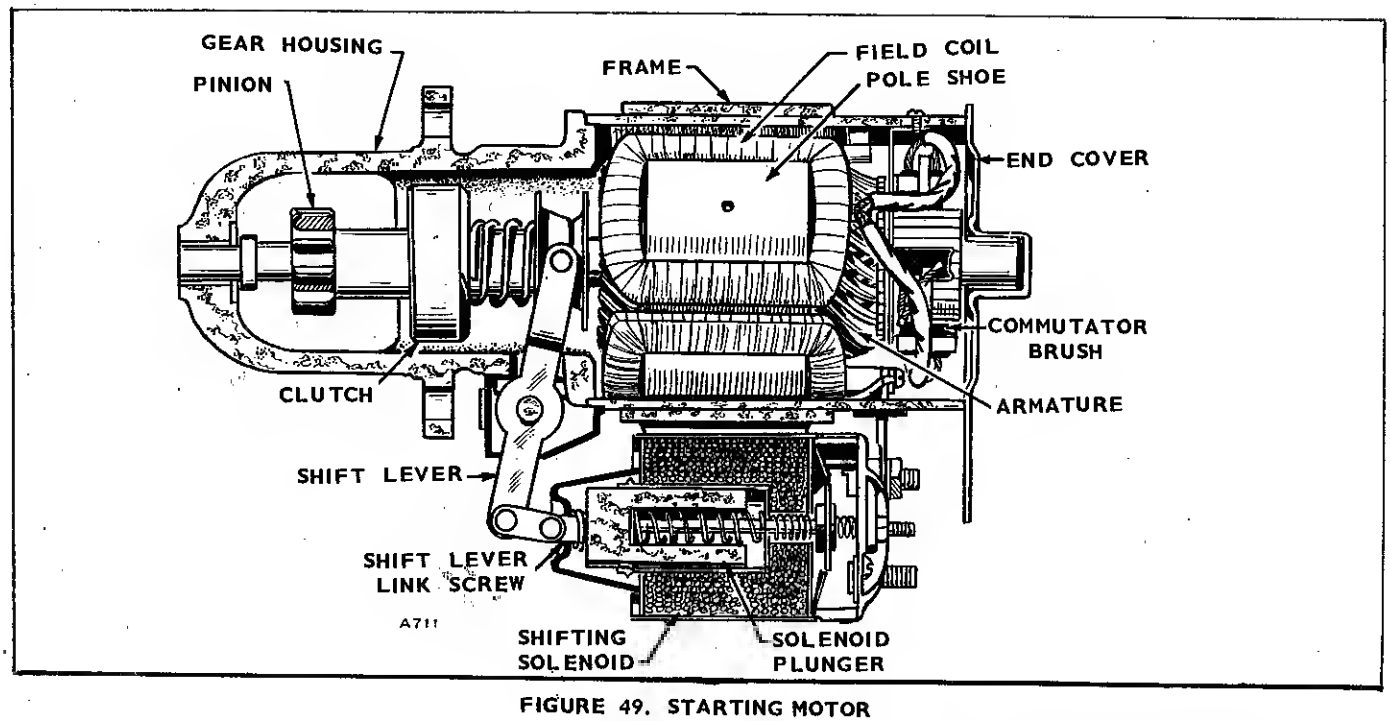


FIGURE 49. STARTING MOTOR

speed.

The torque test (Fig. 48) requires a spring scale and torque arm, voltmeter, ammeter and variable resistance to apply the voltage specified by the test characteristics. The voltage drop across the solenoid on the starting motor should be less than 1.50 volts. If not, remove it for repair.

BATTERY

Plants with a separate cranking motor normally use a single 12 volt battery of at least 72 amp. hour capacity. Exciter cranked plants use 2 six-volt batteries in series. Each battery must be at least 105 amp. hour capacity. Do not use undersize batteries on revolving armature plants as serious armature damage may occur.

The plant battery charging system maintains the batteries, at or near full charge at all times. Inspect the battery charging system and adjust the charge rate if batteries appear to be continually discharged.

NOTE: *Adding accessories that draw battery current requires an adjustment of the charge rate.*

If discharging or failure to charge can't be traced to the battery charging system, thoroughly inspect and test the battery, and replace it if necessary.

REMOVAL AND DISASSEMBLY, STARTING MOTOR

1. Remove electrical connections to control box and battery at the shifting solenoid. Remove the engine front air housing and remove the flywheel.

2. Remove the nut holding the starter rear mounting bracket to the engine. Remove the three capscrews holding the starting motor mounting flange to the crankcase. Then pull the starting motor off the engine. Be careful not to lose any shims that might be behind the flange.

3. Remove the link pin holding the shift lever to the solenoid plunger and remove the shift lever pivot pin.

4. Remove the thru bolts from the commutator end of the motor. Pull off the end cover and lift the brushes off their seats. Pull the cast housing from the front end of the motor and lift the armature and clutch out of the motor frame.

5. To remove the over-running clutch from the armature, drive the retainer away from lockring near the front end of the shaft, remove the lockring and pull the assembly off. Don't attempt to disassemble the clutch assembly.

6. If necessary to service the solenoid, remove the four capscrews and electrical connection holding it to the motor frame. Remove the two screws on the rear of the solenoid to reach the switch contacts.

STARTING MOTOR REPAIR

Armature: Inspect armature for mechanical defects before testing for grounds or shorted coils.

Test for grounds with a 120 volt test lamp. Check between each commutator segment and the shaft. If commutator is grounded, lamp will light and will require replacement. See Figure 50.

CAUTION *Don't touch probes to commutator brush surfaces; it will burn them.*

Use a growler to test for shorted coils. Place armature in growler and run a steel strip over the armature surface. If a coil is shorting, the steel strip becomes magnetized and vibrates. Rotate armature slightly and repeat test for one complete revolution of the armature. If armature is defective, replace it. See Figure 51.

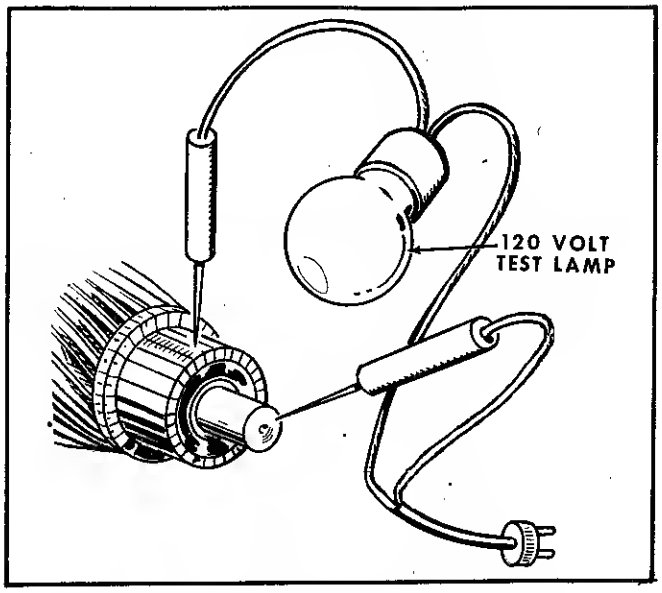


FIGURE 50. TESTING FOR GROUNDS

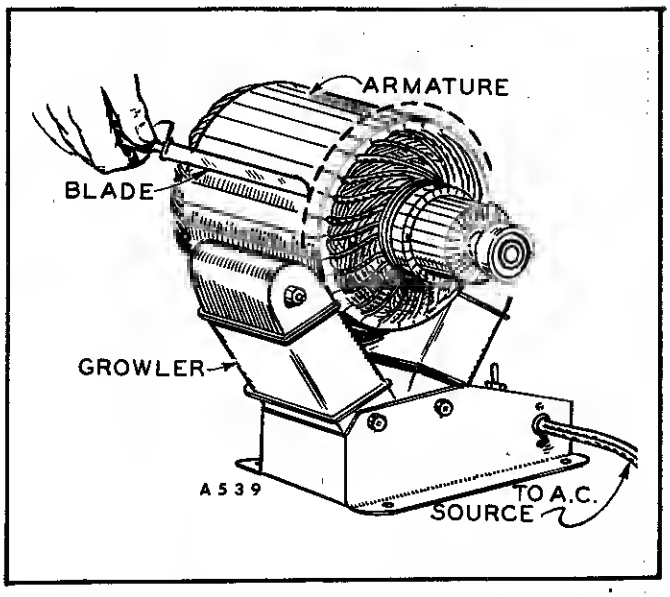


FIGURE 51. TESTING ARMATURE FOR SHORTS

Clean commutator with #00 or #00 sandpaper. Blow the sand out of motor after cleaning. If heavily scored or worn, turn it down in a lathe.

Field Coils: Using a 120 volt test lamp and probea, check the field coils for grounding to the motor frame or open circuit. Inspect all connections to be sure they are properly clinched and soldered. Inspect the insulation for evidences of damage. The only way to check for field coil shorts is to use the starting motor test.

Bearings: If either the front or rear bearings show excessive wear, replace them. Drive the old bearings out, and using an arbor press and the proper arbor, press new bearings into place.

Brushes: Check the brushes for wear or improper seating. They should slide freely in their holders. Check the brush spring tension with a spring scale. To change spring tension, twist the spring at the holder with long nosed pliers.

If brushes are excessively worn, replace them.

Some brushes are soldered to the field lead. To remove these brushes, unsolder the lead and open the loop in the field coil lead. Insert the new brush pigtail completely into the loop and clinch before resoldering. A good soldering job is necessary to ensure good contact and low voltage drop across the connection.

Overrunning Clutch: Clean the clutch thoroughly but don't dip in solvent. It can't be repacked with grease. It should slide easily on the armature shaft with no binding. Turn the pinion; it should rotate smoothly, but not necessarily freely. Reverse the direction a few times and it should instantly lock and unlock. Replace the clutch if operation is defective or pinion is worn or damaged.

Shifting Solenoid: Check that the plunger moves freely in coil. Check pull-in coil continuity between the solenoid control terminal and the solenoid connection to the motor. Check the hold-in coil continuity between the solenoid control terminal and ground on the motor. See NOTES next page.

ASSEMBLY, STARTING MOTOR

Starter motor assembly includes soaking the bronze bearings in oil. These bearings are designed to absorb 25% of their own weight in oil. Be sure the felt oil pad is in the outer end of the commutator end bearing.

After assembly, check the armature end play. It should be .005" to .030". Adjust end play by adding or removing washers at the commutator end.

Check pinion clearance (Figure 52) to ensure engagement. Press solenoid core to shift pinion into full mesh. Measure clearance between pinion and pinion stop. It should be .09" ± .02" (try to get .07"). Adjust solenoid plunger link screw for proper clearance.

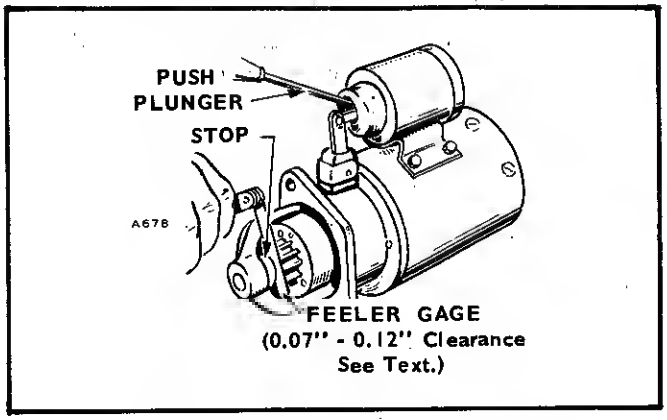


FIGURE 52. STARTER PINION CLEARANCE

NOTE: *On plants built before May, 1962, it was necessary to maintain the gap between ring gear and starter pinion in the relaxed position at less than 1/8" to ensure starter engagement. When installing these motors, check this gap. If it is too great, a shim kit is available to reduce it (Figure 53).*

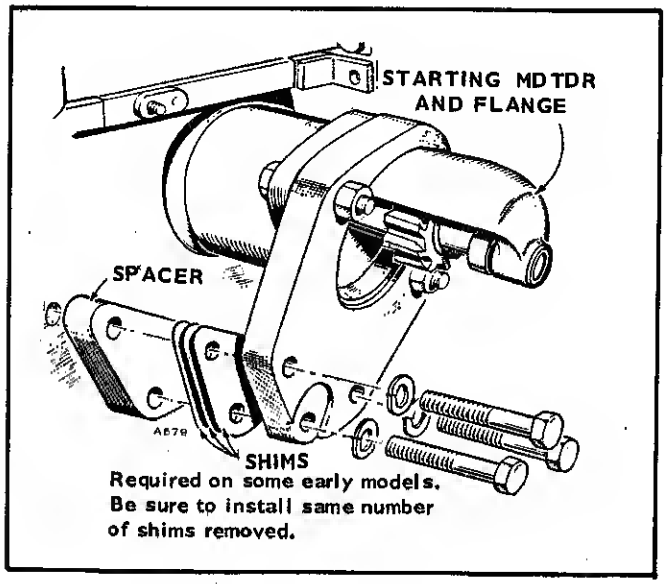


FIGURE 53. ADDING SHIMS

10-86
starter motor does not always engage pinion gear.
O.S. clutch is defective.
upon start, pinion engages flywheel, starter turns but engine will not crank.
This is indicative of a faulty O.S. clutch
P/N 191-432
$108.32 list.

(1) NOTE: shifting solenoid if binding or just not operating properly will cause starter pinion gear to eventually engage the stationary flywheel and causes excessive wear and inability to start.
this can be due to:
① sticky plunger in shifting solenoid
② sticky spline on starter pinion shaft
③ weak shifting solenoid
④ starter pinion clearance dimensions are off
note: these conditions are aggravated by cold weather.

(2) Float 12 volt batteries at 13.2 to 13.6 volts d.c.

→ check this out - See fig. 52 & 53

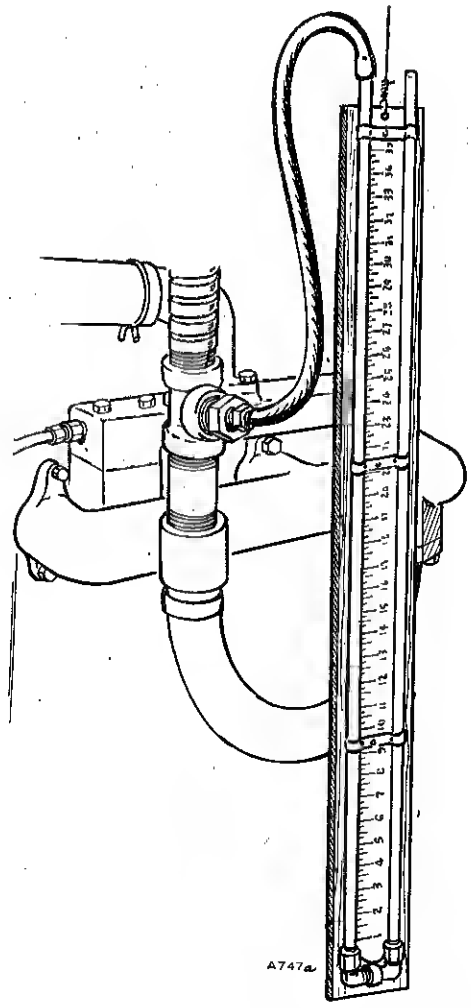
EXHAUST SYSTEM

The importance of exhaust systems (normally supplied by the customer) cannot be over-emphasized. A poor or clogged system causes low power, overheating and engine damage. A poor exhaust system increases back pressure which reduces efficiency. If high back pressure is suspected, follow procedure outlined below.

Test the exhaust system by installing an adapter (or tee) in the exhaust line at the manifold. Connect a manometer or pressure gauge to the adapter. If there is a condensation trap next to the manifold, use it for the manometer connection. Run the plant under full-load and observe the manometer. See Fig. 54 for maximum values. If the reading is higher, the exhaust system should either be disassembled and cleaned or altered to reduce back pressure.

NOTE: ① Do not expose the corrugated stainless steel flexible exhaust section to rotational stress.

② Do not allow weight of exhaust muffler to rest on the exhaust manifold!



UNITS OF MEASUREMENT	FULL LOAD
INCHES OF WATER	40
INCHES OF MERCURY	3
OUNCES	23 OZ

FIGURE 54. EXHAUST BACK PRESSURE MEASUREMENT

ENGINE DISASSEMBLY

This section covers the various assemblies and parts of the engine. All repairs should be accomplished by a competent mechanic. Maintain factory limits and clearances (see Dimension and Clearance Section).

CYLINDER HEADS AND VALVES

Each cylinder head assembly contains valves, valve seat inserts and guides, rocker arms and spark plugs. The valve assemblies are operated by pushrods running through the cylinder head and push rod shields to the camshaft. Exhaust valves are hardened chrome alloy faced and ride on hardened chrome alloy seat inserts; all valves have release type rotaters.

Check the valve clearances at regular intervals. In addition, scrape the combustion chambers clean and inspect the valves and valve seats regularly. If the combustion chambers show excessive carbon build up, reduce the interval between cleaning.

Adjustment: After engine has reached a atable temperature condition the valve clearances may be adjusted. It is recommended that the valve clearance is set with engine at room temperature (approximately 75°F). Allow at least two hours cooling time after engine operation.

Adjust valve clearance on the Two-Cylinder J-Series engines as follows:

1. Turn the flywheel until the cylinder which is to have its valve adjusted on its compression stroke, which follows closing of intake valve.
2. Turn the flywheel until the TC (top center) mark on the flywheel lines up with the timing pointer on the gear cover. Then turn the flywheel in a clockwise direction for an additional 10 to 45 degrees. There is no timing mark for this position so it must be estimated. With the piston located in this position the cylinder will be in its power stroke with both valves completely closed.
3. Check the cylinder head-bolt torque. (See Fig. 60).
4. Using a feeler gauge, check the clearance between the rocker arm and the valve (see Fig. 55). Increase or reduce the clearance until the proper gap is established adjusting with the locknut which secures the rocker arm to the cylinder head. Refer to Table 3 for correct valve clearance setting for your particular engine.

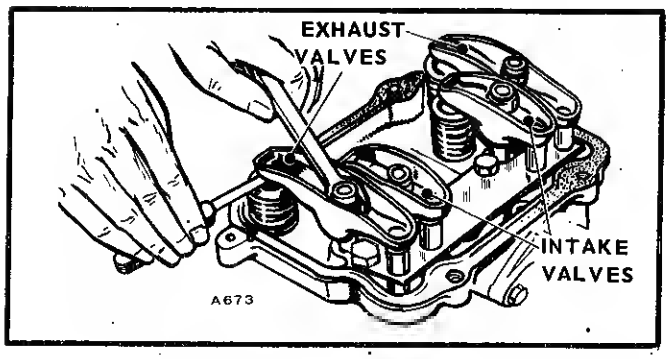


FIGURE 55. ADJUSTING VALVE CLEARANCE

Adjust valve clearance on the Four-Cylinder J-Series engine as follows:

1. Adjust the valve clearance in the firing order (1-2-4-3) sequence. After the cooling period, set timing for the 1 cylinder and the valve clearance.
2. To adjust the valve clearance for the number 2 cylinder, turn the flywheel in a clockwise direction 180° (1/2 revolution) from the position used in step 2-A. The flywheel position should be between 10° and 45° past the BC (bottom center) flywheel mark.

NOTE: Early model four-cylinder engines do not have a BC mark on the flywheel.

3. After timing the number 2 cylinder, adjust the valve clearance (refer to two-cylinder adjustment).
4. To adjust the valve clearance for the number 4 cylinder, turn the flywheel in a clockwise direction 180° (1/2 revolution). The flywheel should be between 10° and 45° past the TC flywheel mark.
5. After timing the number 4 cylinder, adjust the valve clearance.
6. To adjust the valve clearance for the number 3 cylinder, turn the flywheel in a clockwise direction 180° (1/2 revolution). The flywheel should be between 10° and 45° past the BC flywheel mark.

	GASOLINE		GAS, COMBINATION GAS-GASOLINE
	BEGIN SPEC D	PRIOR TO SPEC D	
INTAKE	.012″	.010″	.013″
EXHAUST	.015″	.013″	.020″

TABLE 3. VALVE CLEARANCE FOR JB, JC

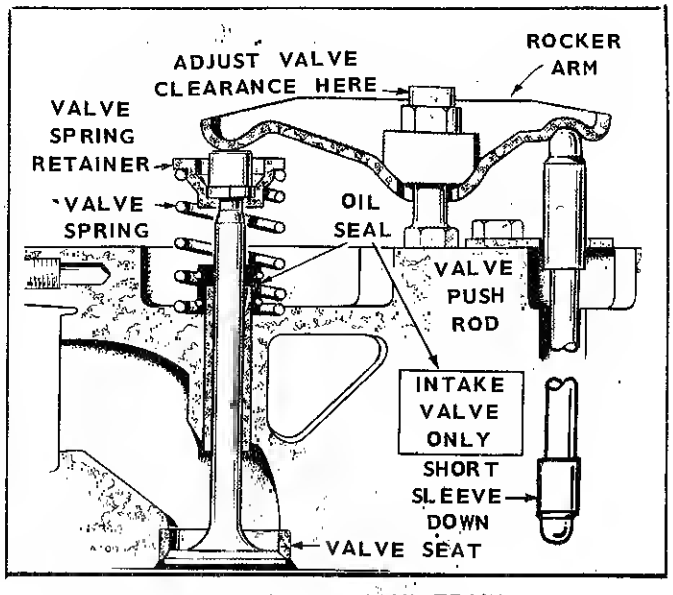


FIGURE 56. VALVE TRAIN

7. After timing the number 3 cylinder, adjust the valve clearance.

Testing: Run the engine until thoroughly warm. Stop and remove all spark plugs. Insert the compression gauge in a spark plug hole, crank the engine, and note the reading. To check for piston blow-by, squirt a small amount of SAE 50 oil into the cylinder and repeat the check. An increase in compression with oil in the cylinder indicates piston blow-by.

Compreasion of a atandard new engine cranking at about 300 rpm is about 110 psi. Compression should be fairly uniform, normally with less than 10 psi difference between the highest and loweat cylinder, taken at the same cranking rpm. Excea-sively high readings indicate carboned combustion chambers.
#1 = 90# #2 = 87# 43 hrs
Compression readings will change because of differences in cranking speed, altitude and ambient temperature conditions. There the limits are given only as a guide. The best indication of leakage is the pressure difference between cylinders or a compression increase when oil is added to the cylinder.

Disassembly:

NOTE: Valves, tappets, rocker arms and pushrods should be kept in order and returned in same order.

1. Remove the rocker box cover, spark plugs and connecting oil lines to the cylinder heads. Remove the intake and exhaust manifold.

2. Remove the capscrews holding each cylinder head to the cylinder block.

3. Remove each head. If it sticks, rap it sharply with a soft hammer. Don't use a pry.

4. Remove the rocker arms and pushrods.

5. Using a valve spring compressor, disassemble the valve assemblies.

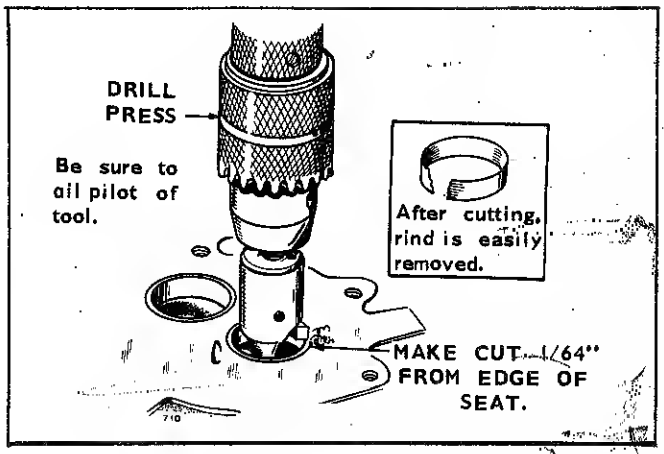


FIGURE 57. REMOVING VALVE SEAT

Repair: Thoroughly clean all components of the cylinder assemblies. Remove all the carbon deposits from the combustion chambers and clean all gasket surfaces.

Remove all carbon and check each valve for burning, pitting or warped stem. Valves that are slightly pitted or burned, refinish on an accurate valve grinder to a 45° angle. But, if they are badly pitted, or will have a thin edge when refaced, replace them.

Check refinished valves for a tight seat to the valve seat with an air pressure type testing tool or by applying Prussian Blue on the valve face and rotating it against the seat.

Check valve-guide-to-valve clearance. If the proper clearancea can't be obtained by replacing the valvea, replace the valve guides. Drive the old valve guides into the valve chambers. Drive new guides in until they protrude 11/32" from the rocker box side of the head. Ream the new valve guide to obtain the proper clearance (see Dimensions and Clearances Section).

If the valve seats are pitted, refinish them. Using conventional seat grinding equipment, reface each seat to a 45° angle and a seat width of 3/64" to 1/16". You should be able to reface each seat several times before it becomes necessary to replace it.

If, however, the valve seats are loose or cannot be refaced, replace them.

Use Onan #420A272 in a drill press (Fig. 57) to remove each valve seat. Adjust the tool to cut 1/64" from the edge of the seat.

Oil the pilot to prevent seizing in the valve guide. Cut each seat down to a narrow rind on edges and bottom and break it out with a sharp tool. Be careful not to cut into the counterbore bottom.

Thoroughly clean the valve seat counterbore and remove any burrs from the edges. If the counterbore is damaged, machine for an oversize seat. Oversize seats are available in .002", .005", .010" and .025". Otherwise, install new standard size seat inserts.

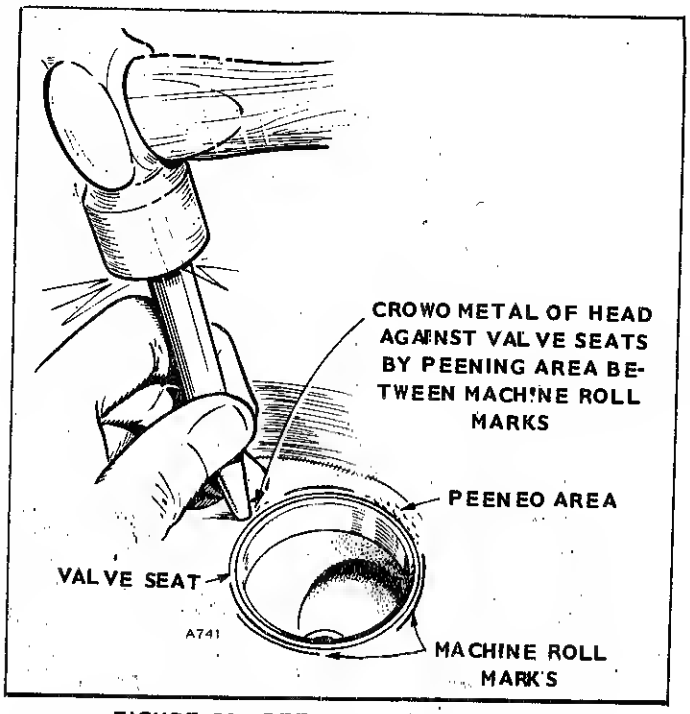


FIGURE 58. PEENING HEAO MATERIAL

Drive the new valve seat inserts into place. Each seat must rest solidly on the bottom of the counterbore at all points. To ease installation, heat the cylinder head in an oven at at 325°F for about 1/2 hour and cool the valve seats in dry ice.

After installation and before facing the new seats, peen the head material against the valve seat in the 3 areas between the machine roll marks (Fig. 58).

Face each new seat to a 45° angle and width of approximately 3/64". The finished seat face should contact approximately center of the valve face. Use Prussian Blue on each valve face to check this. Make corrections to the seat, not the valve face.

Check the valve springs on an accurate compression scale. Replace any spring that is weak, cracked or pitted or has ends out of square. See Dimension and Clearance Section for valve spring data.

INSTALLATION:

1. Push a new valve stem oil seal onto each intake valve guide and clamp in place. Then oil the inside surface of each seal.

NOTE: Plants built before June 1962 had no valve seals.

2. Oil the stem of each valve lightly and insert each in it's own guide.

3. Check each valve for a tight seat with an air pressure type tester. If a tester isn't available, make pencil marks at intervals on the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn in the seat. If the seat isn't tight, regrind the valves.

4. Using a valve spring compressor, compress each valve spring with its spring retainer in place and insert the retainer locks.

5. Coat both sides of head gasket with Permatex No. 3 (pliable sealer). Install the head assembly and gasket to the cylinder block. Tighten the head bolts one or two turns.

6. Make up push rod shield assemblies by installing an "O" ring on one end of the rod and a spring, washer, and "O" ring on the opposite end. Lift the cylinder heads and install the pushrod shield assemblies (Fig. 59).

7. Tighten the head bolts to 28 to 30 lbs. ft. following the sequence in Fig. 60.

NOTE: *4-cylinder models; observe the following special procedure to align the two heads and prevent air leaks.*

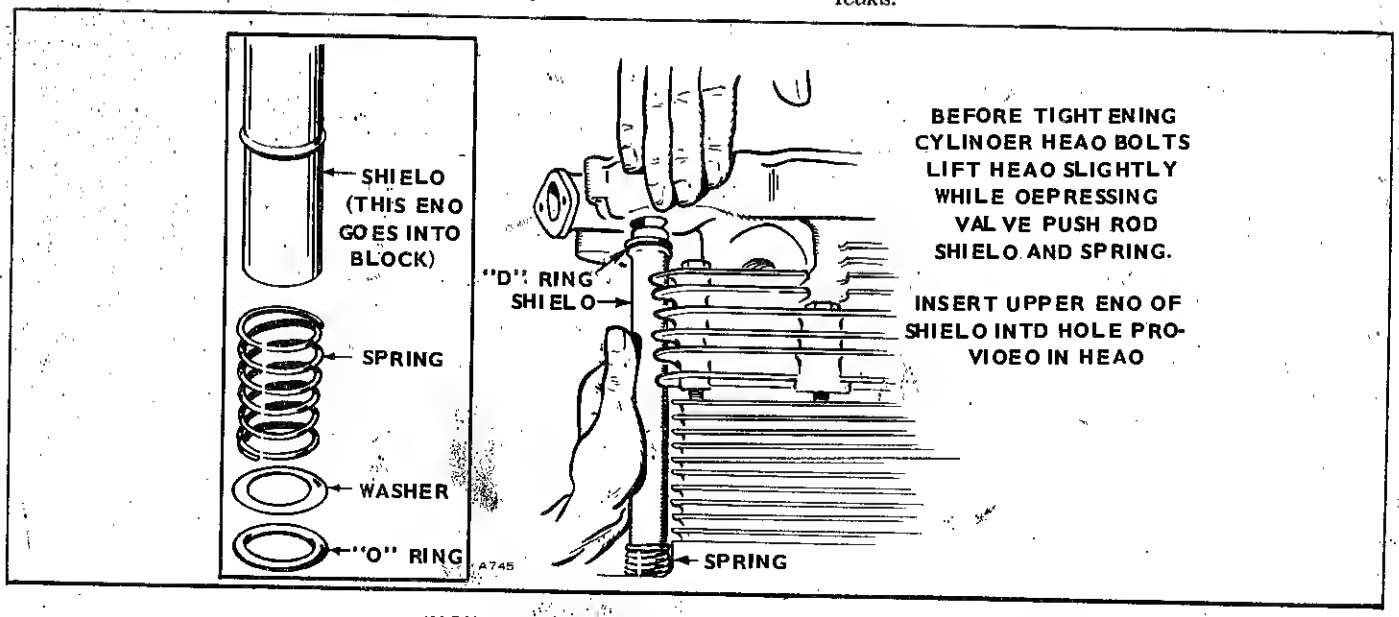


FIGURE 59. INSTALLING PUSH ROD HOUSING

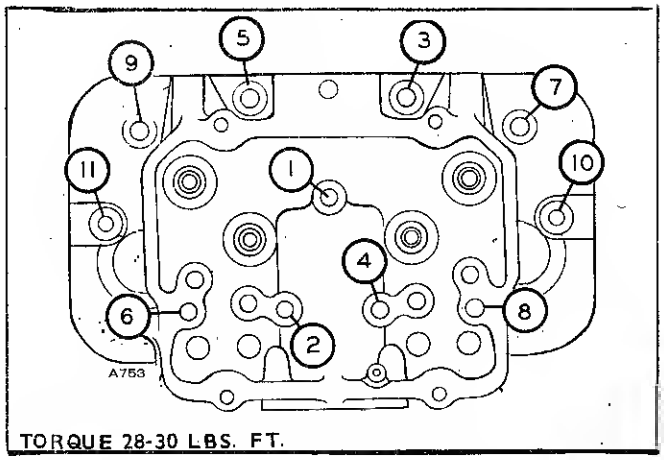


FIGURE 60. HEAD BOLT TIGHTENING SEQUENCE

a. Assemble the heads, gaskets, and pushrod shields to the block and install the cap screws, but don't tighten.

b. Install the intake manifold to the heads and tighten the nuts to 13 - 15 lbs. ft.

c. Tighten the cylinder head capscrews following the sequence in Fig. 60 .

8. Install the exhaust manifold, oil lines, spark plugs and carburetor. Install the valve stem caps. Install the push-rods, rocker arms, and rocker arm nuts.

9. Set the valve clearance according to Table 3.

NOTE: *After the first 50 hours of operation, retighten the cylinder head bolts and recheck valve clearance.*

10. Reinstall the rocker box cover, air housing and access door.

PISTONS, CONNECTING RODS, CYLINDERS

Each cam ground aluminum piston is tapered and fitted with two compression rings and an oil control ring. Full floating piston pins, held in place with snap rings, connect the piston to its connecting rod. The lower end of each connecting rod contains half steel, precision bearings and the upper end, semi-finished bushings.

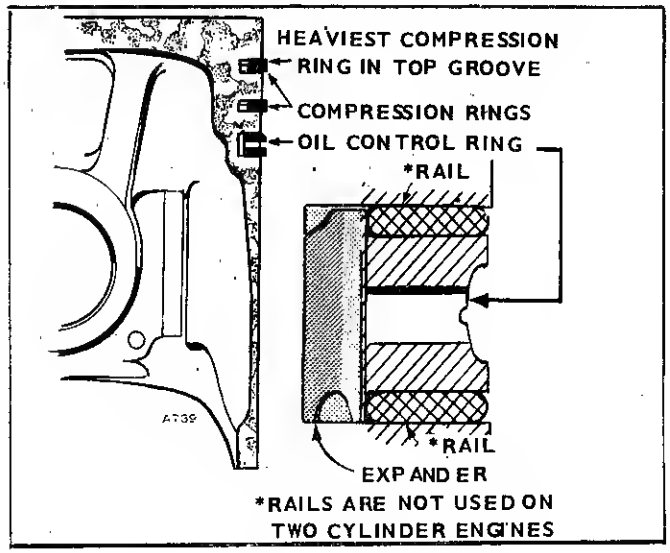


FIGURE 61. PISTON RINGS

NOTE: *Plants marked with an E following the plant serial number are fitted with .005 in. oversize pistons at the factory. Use standard rings for these pistons.*

Removal and Disossembly: Connecting rods and caps are stamped with numbers for installation in the proper cylinder. When removing piston assemblies, check marking so each can be re-installed in the proper cylinder. Keep all components of each piston assembly together.

1. Drain the crankcase oil and remove the oil base, air housing and cylinder heads.

2. Scrape off the carbon ring and ridge at the top of each cylinder to prevent damaging rings or pistons. Onan stocks a ridge reamer for this purpose.

3. Remove the connecting rod cap and push the assembly through the top of the cylinder bore. If the ridge at the top of the cylinder interferes with piston removal, cut it down with a ridge remover before taking the piston assembly out.

4. Using a ring expander, remove the rings from each piston.

5. Remove the two retaining rings and push the piston pin from each piston.

Cylinders: The cylinder walls should be free of scratches, pitting and evidence of wear. Check with an inside reading micrometer for excessive out-of-round or taper. New cylinder dimensions are 3.2495" to 3.2505".

If necessary, rebore the cylinder to fit the next oversize piston. Pistons and ring sets are available in., .010", .020" and .030" oversize. If refinishing is not required remove any ridges from the top of the wall with a ridge cutter, or if the ridge is small, a de-glazing stone.

Pistons: Clean the carbon from the ring grooves and be sure all oil holes are open. If any piston is badly scored or burred, loose in the cylinders, has badly worn ring grooves or otherwise isn't in good condition, replace it.

Check clearance by inserting each piston in its cylinder. Check the clearance 90° from the axis of the piston pin and 3/8" below the oil control ring. Clearance should be .0012" – .0032". If it isn't within the limit, replace the piston and check the cylinder bore size.

Piston Pins: Each pin should be a thumb push fit into its piston at room temperatures. If the pin is excessively loose, install a new pin or the next oversize pin. If the piston is worn so that the oversize pin won't fit, replace the piston.

Rings: Inspect each ring carefully for fit in the piston grooves and seating on the cylinder wall. Fit each ring to the cylinder wall at the bottom of its travel, using a piston to square the ring in the bore. Check the end gap with a feeler gauge (Fig. 62). It should be .010" to .020". If the gap is too small, file the butt ends of the rings. Don't use rings that need a lot of filing, they won't seat right on the

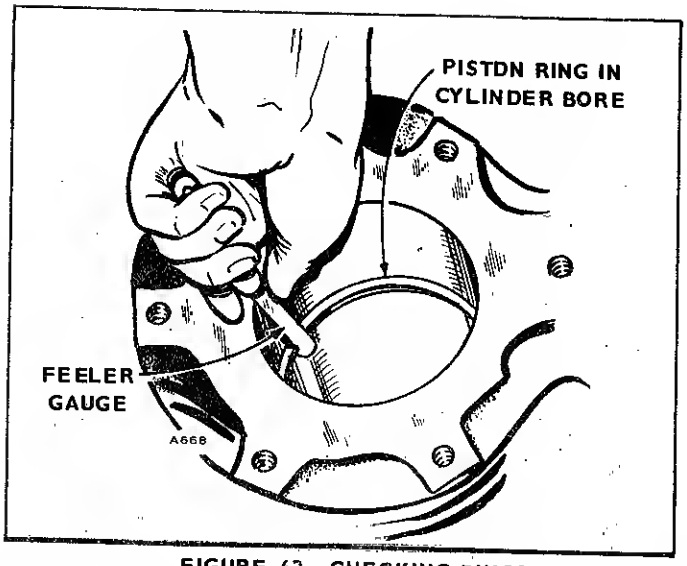


FIGURE 62. CHECKING RINGS

cylinder walls. If oversize pistons are used, use the correct oversize rings.

During piston ring replacement de-glaze the cylinder walls with either a de-glazing hone or emery paper. Don't change the diameter of the cylinder bore. Create a cross hatch pattern on the cylinder walls. After de-glazing, be sure to completely clean the cylinder walls and the rest of the engine, to remove all residue.

Connecting Rods: Clean each connecting rod and check for defects. Check the upper connecting rod bushings for proper piston pin clearance. Clearance should be .0002" to .0007".

Press out excessively worn bushings and install new bushings. Press the new bushings in until they are centered in the connecting rod (Fig. 63). . After installation, drill the bushings with a 3/16" drill through the counterbored hole in the connecting rod top. Be sure the connecting rod oil spray hole is open.

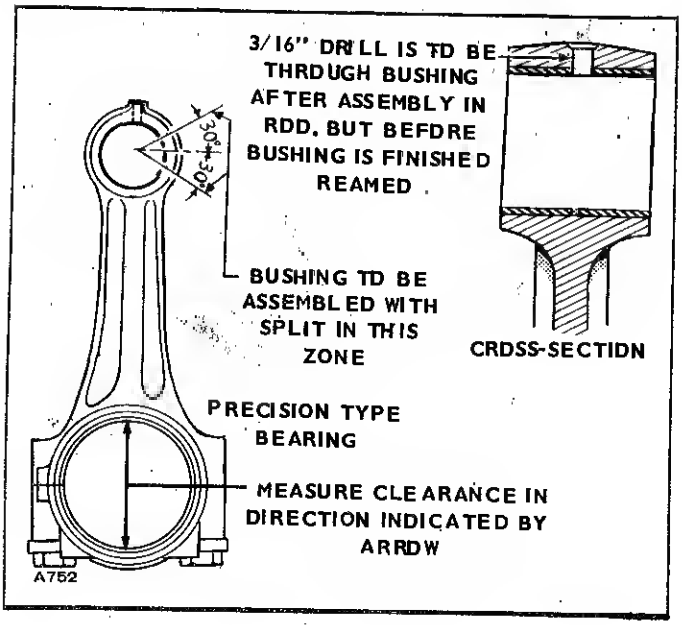


FIGURE 63. CONNECTING ROD BUSHING

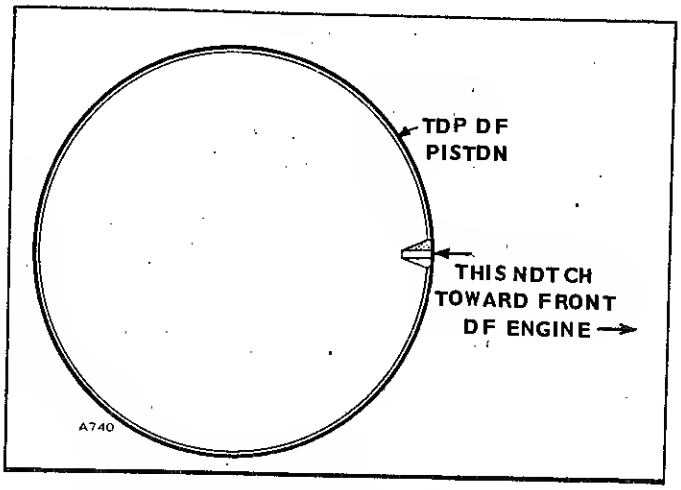


FIGURE 64. PROPER PISTON ALIGNMENT

Connecting Rod Bearings: Inspect the connecting rod bearings for burrs, breaks, pitts and wear. Measure the clearance between bearings and the crankshaft journal. The clearance should be .001" to .003". If necessary, replace with new standard or oversize precision bearings. Refer to dimensions and clearances for journal size.

1. Install the connecting rods on each piston with pins and retaining pins. Install so the connecting rod oil spray hole is on the same side as the "V" notch in each piston.

2. Install all rings on each piston. Tapered type rings are marked "TOP" or identified in some other manner. Place this mark toward the closed end of the piston. Space the ring gaps 1/3 of the way around the piston from one another. No gap should be in line with the piston pin. Oil the rings and pistons.

3. Position a bearing half in each connecting rod. Be sure there is no dirt under the bearing. This could cause high spots and early bearing failure.

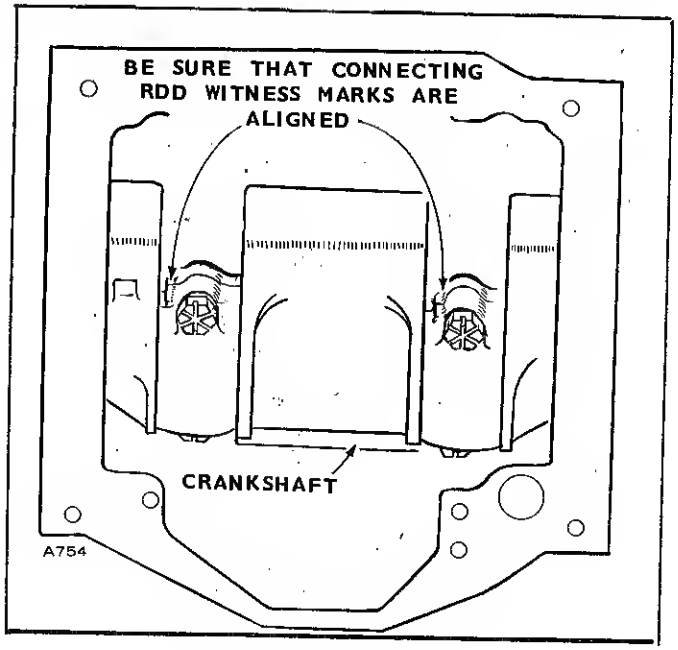


FIGURE 65. INSTALLING ROD CAP

4. Oil the cylinder walls and pistons. Install each piston in the proper cylinder using a suitable installer. Each assembly should be installed with the "V" mark on the piston toward the front of the engine.

5. Position each connecting rod on the crankshaft, oil the journal and install its rod cap with bearing half. When installing the rod cap, position so the raised witness mark on the forging matches the mark on the connecting rod (Fig. 65).

6. Tighten the connecting rod capscrews to the specified torque.

7. Crank the engine over by hand to see that all bearings are free.

8. Install the oil base with a new gasket. Install the cylinder heads.

Break-In Period: Whenever new rings or pistons are installed or the cylinder refinished, the engine must be run-in before regular operation. Run the engine for 15 - 20 minutes at no load, about 1/2 hour at 1/3 load and 2 - 3 hours at 2/3 load. Then resume regular operation.

Avoid light loads during balance of break-in period to best seat rings for oil control.

ENGINE DISASSEMBLY

During engine disassembly, observe the following order (i.e. Flywheel, Gear Cover ...). As disassembly progresses, the order may be changed somewhat as will be self-evident.

The engine assembly procedure is the reverse of disassembly. Any special assembly instructions for a particular component are included. When reassembling check for special assembly instructions or procedures.

Flywheel: To remove the flywheel, first remove the blower housing. The flywheel is then removed by using the crank dog as a puller as follows: first remove the crank dog and flywheel mounting capscrew. Then remove the large washer from the flywheel mounting capscrew and reinstall the screw part way. Install the washer into the crank dog and mount the crank dog so the washer bears against the end of the flywheel mounting screw. Tighten the 2 crank dog capscrews alternately until the flywheel comes loose.

Ring Gear: Remove the ring gear by sawing part way through, then break it using a cold chiesel and heavy hammer.

To install a new ring gear, place it in an oven heated to 380 - 400° for 30 to 40 minutes. When heated properly, the ring will fall into place on the flywheel. If it binds, drive it into place with a hammer. Do it fast and don't damage the gear teeth. The ring will contract rapidly and may shrink to the flywheel before it is in place. If this occurs, a new ring gear may be required.

CAUTION *DON'T HEAT WITH A TORCH!*

Gear Cover: To remove the gear cover, detach the upper governor ball joint and remove the ignition breaker points (start-disconnect switch), plate and gear. Remove the screws holding the gear cover to the crankcase. To loosen the gear cover, tap it with a soft hammer.

Governor Shaft: Two sets of needle bearings support the governor shaft. To remove the shaft from the gear cover, remove the governor yoke and pull the shaft from the gear

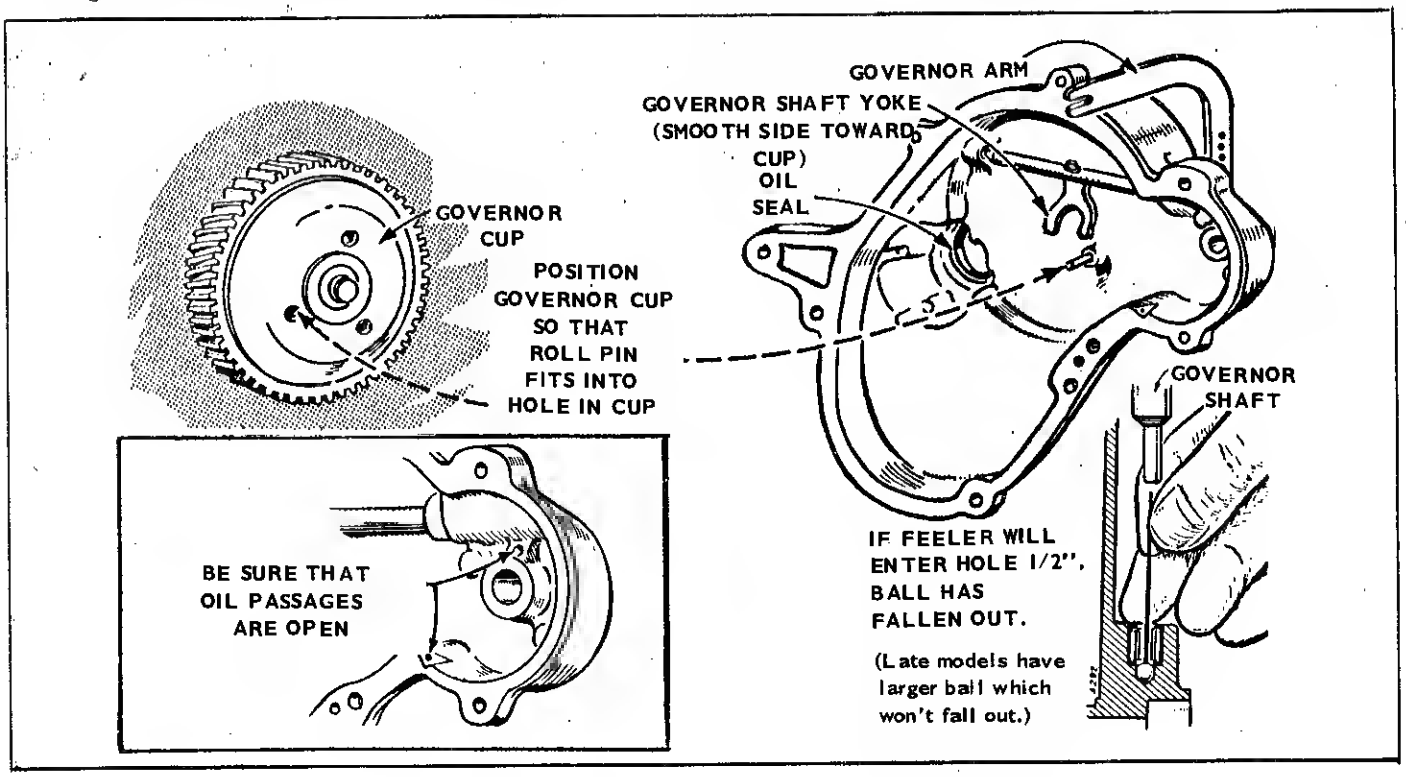


FIGURE 66. GEAR COVER AND GOVERNOR SHAFT

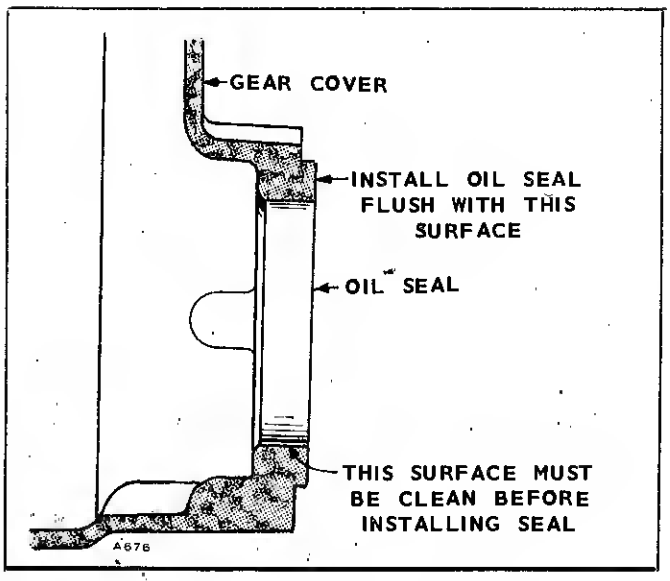


FIGURE 67. GEAR COVER OIL SEAL

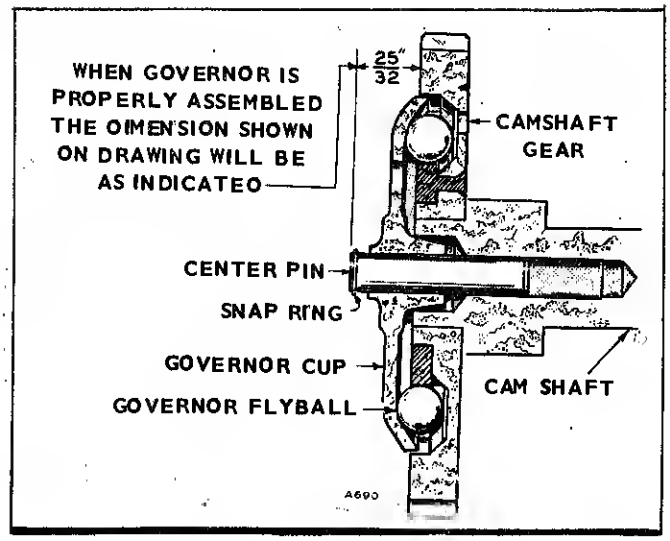


FIGURE 68. GOVERNOR CUP

cover. If the shaft binds during operation, clean the bearings, if loose, replace the bearings. To remove the larger bearing, drive both bearing and oil seal out from the outside of the gear cover. Remove the smaller bearing with an Easy-Out or similar tool. Press new bearings and oil seal into place.

Gear Cover Oil Seal: Replace the oil seal if damaged or worn. Drive the old seal out from inside the gear cover. Lay the cover on a board so the seal boss is supported. Using an oil seal driver, insert the new seal from the inside with rubber lip toward outside of gear cover (open side of seal inward) and drive it flush with the outside surface (Fig. 67). During gear cover installation, reverse the driver to protect the oil seal. Lubricate lips with heavy grease.

1. Operate the governor shaft to check for binding and see that the governor-shaft-end-thrust ball is in place (Fig. 66).

2. Turn governor yoke so the smooth side is toward governor cup. Set the governor cup so the stop pin in the gear cover will fit into one of the holes in the cup surface (Fig. 66). Measure the distance from the end of the stop pin to the mounting face of the cover. It should be 25/32". If not, replace the pin. Position open edge of pin toward crankshaft seal to avoid governor cup drag.

3. Use an oil seal driver (or a piece of shim stock over the crankshaft keyway) to protect the oil seal and install the gear cover. Tighten the mounting screws to specified torque. Before tightening the screws, be sure the stop pin is in the governor cup hole (Fig. 66).

4. Install and time the ignition points on JB (see Ignition System). Install and gap the centrifugal switch on JC (See Control System).

Governor Cup: To remove the governor cup, remove the snap ring from the camshaft center pin and slide the cup off. Catch the ten flyballs that will fall out when the cup is removed. Replace any flyballs that have flat spots or grooves. Replace the cup if the race surface is grooved or rough. The governor cup must be a free spinning fit on the camshaft center pin, but should be replaced if excessively loose or wobbly.

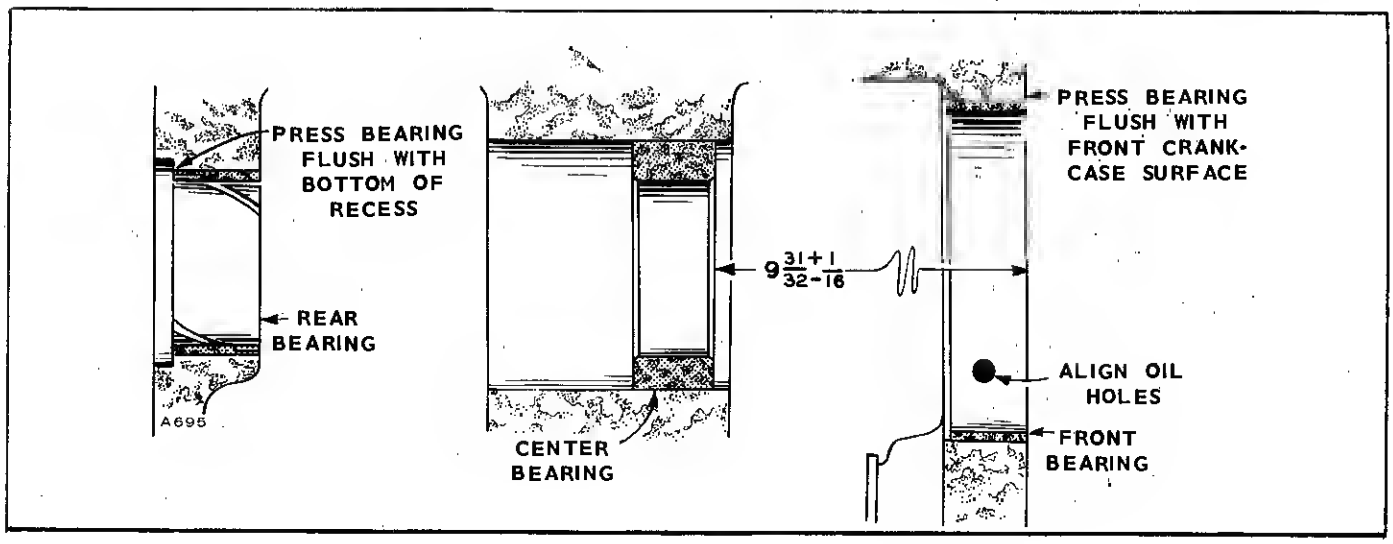


FIGURE 69. CAMSHAFT BEARING ALIGNMENT

The distance the center pin extends from the camshaft gear must be 25/32" to give the proper travel distance for the cup. If less, the engine may race; if more, the cup won't hold the balls properly. If the distance is too great, drive or press the center pin in. If it is too small, replace the pin; it can't be removed without damaging the surface. In some cases, if the distance is too small, the head of the governor cup can be ground to give the necessary 7/32" travel distance.

To install the governor assembly, tip the front of the plant upward. Set the flyballs in their recesses and position the governor cup on its shaft. Install the snap ring on the center pin.

Camshaft: The camshaft is a one piece machined casting, driven through gears by the crankshaft. It rides on sleeve bearings pressed into the crankcase.

In addition to opening and closing the valves, the camshaft operates the fuel pump and, on JC plants, the distributor.

Remove the camshaft as follows:

1. Remove the rocker arms and pushrods from the valve chambers.
2. Remove fuel pump from the engine. Remove the distributor(JC only).
3. Remove the crankshaft gear retaining washer by removing the lock ring on the crankshaft.
4. Lay the engine on side to avoid dropping tappets and remove the camshaft assembly as a group. If necessary, pry it out with a screwdriver between the camshaft gear and crankcase.

CAUTION *Be sure the camshaft lobes don't catch on pushrod tappets during removals.*

5. Remove the tappets from the camshaft end of the pushrod holes.

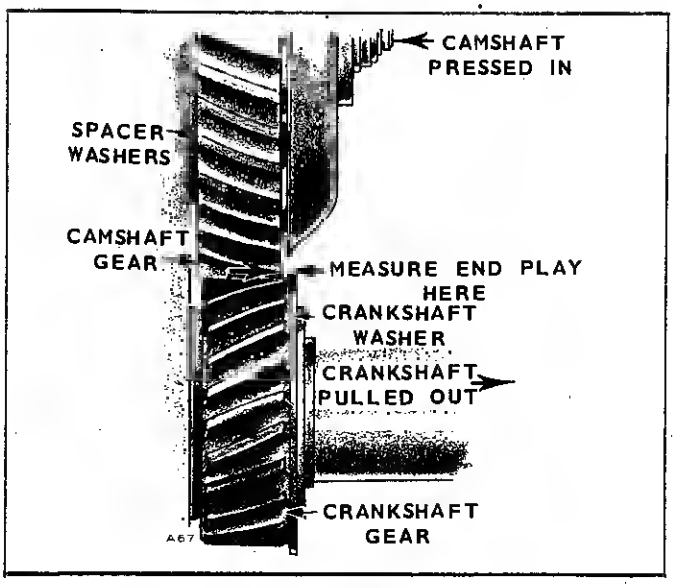


FIGURE 70. CAMSHAFT END PLAY

If a lobe is slightly scored, dress it smooth with a fine stone. If the camshaft is badly worn or scored, replace it.

The camshaft gear is a pressed fit on the camshaft and drives it at 1/2 the crankshaft speed. The gear drives the ignition timing (start-disconnect switch on 4 cylinder) gear on 2 cylinder models. To remove; use a hollow tool or pipe that will fit inside the gear bore and over the center pin. Press the camshaft out of the gear bore. Be careful not to damage the center pin.

The camshaft bearings should be replaced if the clearance to the camshaft is greater than specified; or if the bearings show cracks, breaks, burrs, excessive wear, or other defects.

The camshaft to bearing clearance should be .0012" to .0037". To check the rear bearing, remove the expansion plug at the rear of the crankcase.

Press new bearings into place (Fig. 69) using bearing driving tool. Press the rear bearing flush with the bottom of expansion plug recess. Press the front bearing in flush with the crankcase front surface so the crankcase and bearing oil passages align. After the rear bearing is installed, insert a new expansion plug in the recess, using sealing compound, and expand it into place with sharp blows at its center. The bearings are precision type and do not require reaming. Install the camshaft assembly as follows:

1. Install the key and press the camshaft gear on its shaft. Mount the governor components.
2. Slide the thrust washer onto the shaft.
3. Lay the engine on side or end and insert the pushrod tappets.
4. Install the camshaft assembly in the engine. Align the timing marks on the camshaft gear and crankshaft gear (Fig. 71).
5. Replace the pushrods and fuel pump. Install and retime the distributor (JC only).

Crankshaft: The engines use a counterbalanced, ductile iron

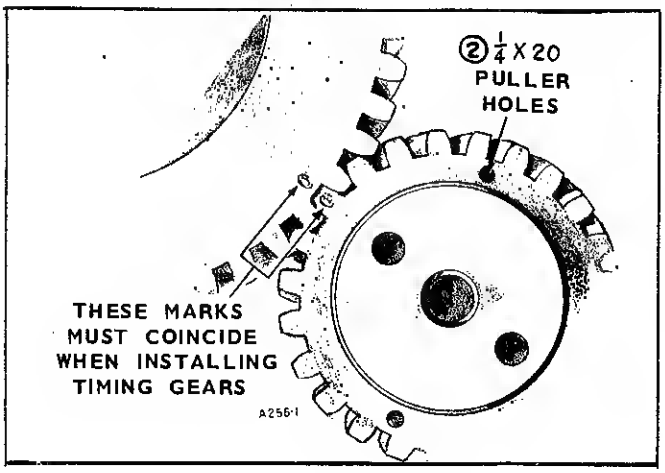


FIGURE 71. TIMING GEAR MARKS

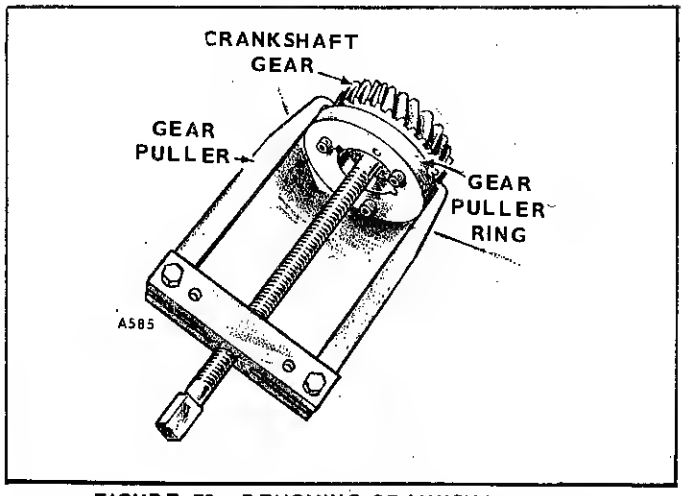


FIGURE 72. REMOVING CRANKSHAFT GEAR

crankshaft. The two cylinder crankshafts ride on a two lead-bronze bearings, the front one housed in the crankcase and the rear one in the bearing plate. The four cylinder model uses an additional split center main bearing.

Remove the crankshaft as follows:

1. Remove the lock ring and retaining washer in front of the crankshaft gear.

2. Pull off the crankshaft gear. It has two 1/4-20 UNC tapped holes for attaching a gear pulling ring (Onan tool 420A275). Use care not to damage teeth if the gear is to be reused.

3. Remove the oil pan and tha piston-and-connecting-rod assemblies.

4. FOUR CYLINDER ONLY. Remove the bearing cap from the center main bearing.

5. Remove the rear bearing plate from the crankcase. Retain or measure the thickness of the rear bearing plate gaskets. These gaskets determine crankshaft endplay.

6. Remove the crankshaft through the rear opening in the crankcase. (4-Cylinder Only. Catch the upper half of the main bearing support as it slides off its mounting surface).

Thoroughly clean and inspect the crankshaft and blow out all oil passages with compressed air. Check all journals for out-of-round, taper, grooving or ridges. Pay particular attention to ridges or grooves on either side of the oil hole areas which indicate neglect of oil cleanliness.

If the journal dimensions are not within the limits or the journals are scored, machine the crankshaft. Crankshaft machining requires a trained and experienced operator and suitable equipment.

Undersize bearings and connecting rods are available to rework the shaft to .010", .020", and .030" undersize.

If main bearing clearances are greater than the limits or the bearings are worn, grooved or broken, replace them. Precision replacement bearing inserts and thrust washers are available for all main bearings. Don't ream the precision type bearings. Refer to dimension and clearance section for crankshaft tolerances.

Align the oil holes and press the new bearings into the front and rear housings. Insert the JC center bearing when the crankshaft is installed.

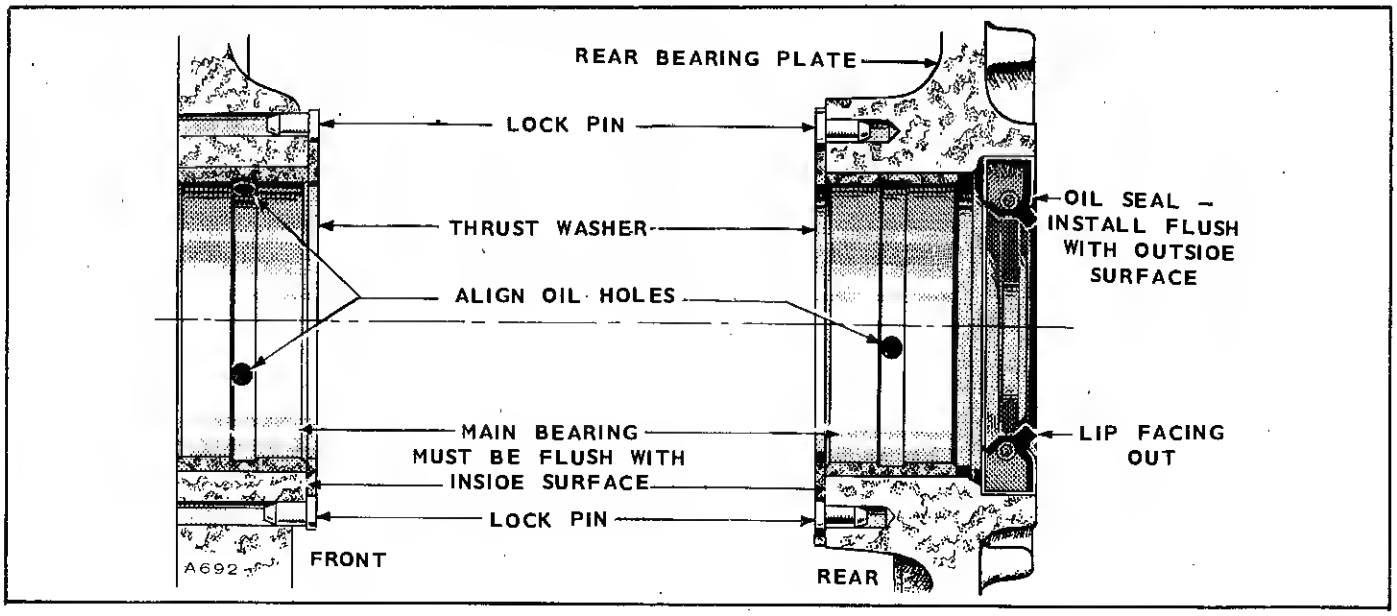


FIGURE 73. MAIN BEARING HOUSING

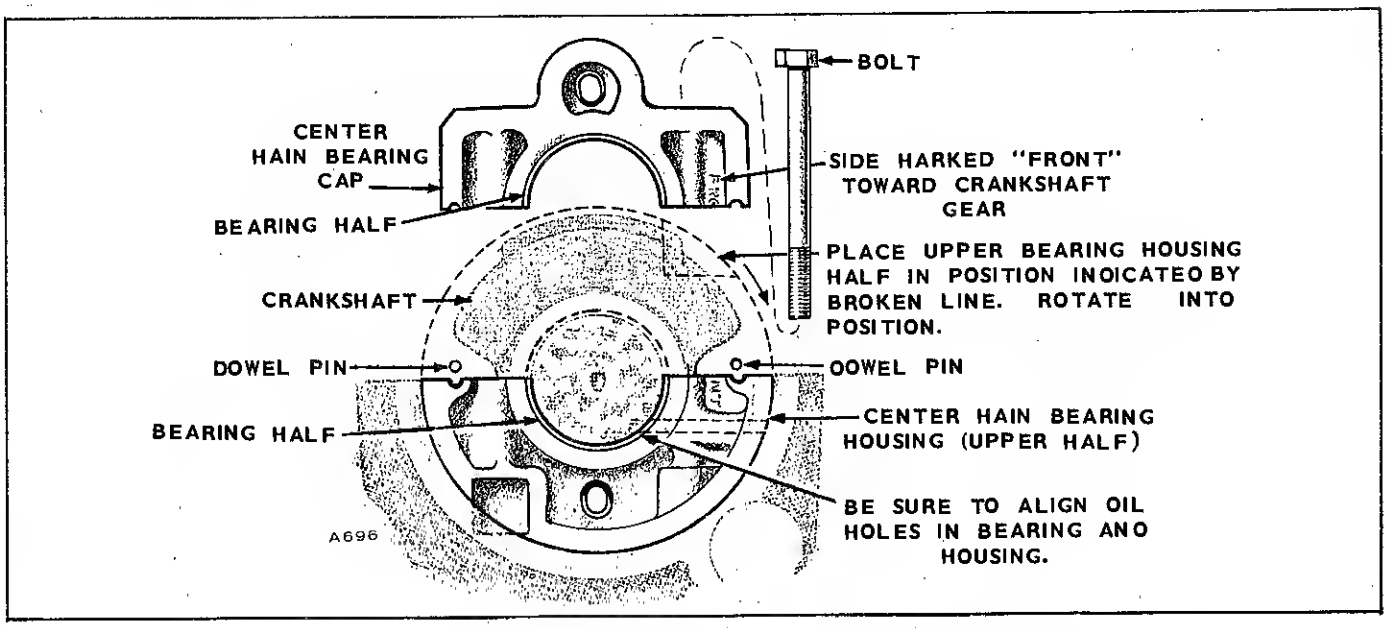


FIGURE 74. MAIN BEARING INSTALLATION

The crankshaft rear oil seal is in the rear bearing plate. If damaged, drive it out from the inside of the plate. Using the oil seal installing tool, install a new seal with the rubber lip facing outward (open side of seal inward Fig. 73). Drive the new seal flush with the rear surface of the bearing plate. Leave the seal installer on during bearing plate installation to protect the oil seal. Lubricate lips with heavy (high temperature) grease.

Install the crankshaft aa follows: after each step, turn the the crankshaft to be sure it ia not seized.

1. Press the front and rear main bearinga into place, align the bearing and bearing housing oil holes. Don't attempt to drive a bearing into a cold block or rear bearing plate. Install the thrust washers and locking pins.

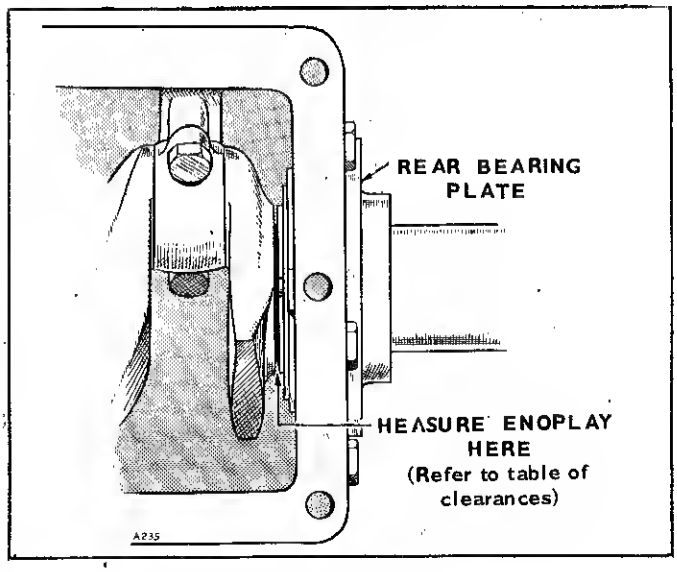


FIGURE 75. CRANKSHAFT END PLAY

2. Oil the bearing surfaces and install the crankshaft from the rear of the crankcase, through the rear bearing plate hole.

3. Mount and secure the rear bearing plate with the same thickness of new gasketa as removed.

4. Hent the crank gear to about 350°F. Install the key on the crankshaft, then drive the gear into place. Install the retaining washer and lockring.

5. 4-CYLINDER ONLY. Set the upper half of the center main housing on the crankshaft and rotate it into place. Be sure the side marked FRONT is toward the crankshaft gear. Set the 2 positioning dowels on the upper bearing mount. Install the center main bearing cap and torque bolts to 97 - 102 lb. ft. (Fig. 74).

6. Check the crankshaft end play. Use enough rear bearing plate gaskets to provide .010" to .015" end play (Fig. 75).

7. Install piston assemblies.

Crankcase: On the 4-cylinder models, if the center main bearing support requires replacement, the whole crankcase must be replaced or returned to the factory to have a new housing fitted.

AC GENERATOR MAINTENANCE

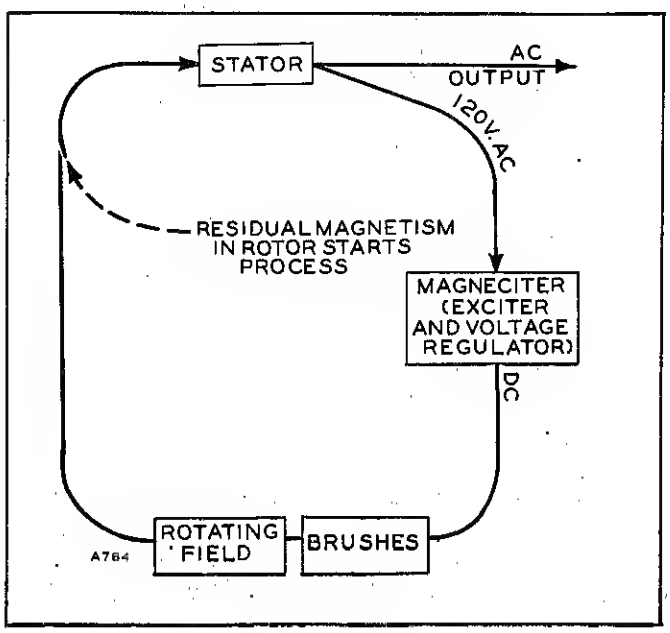


FIGURE 76. EXCITATION SCHEMATIC

This section covers the revolving field generator and static exciter (Magneoiter) and the revolving armature generator.

GENERATOR REVOLVING FIELD

The 7.5JB, JC, and 50 Cycle 6JB plants use a 4 pole revolving field generator with static exciter (Magneciter) to excite the field and regulate the plant's AC output (Fig. 76).

The generator is mounted to the engine crankcase through the engine-to-generator adapter. The rotor connects directly through a tapered fit with key to the engine crankshaft. A ball bearing, housed in the generator endbell, supports the outboard (collector ring) end of the rotor. The endbell is supported by studs through the stator assembly to the adapter. The generator can't be removed from the engine as a complete unit (Fig. 77).

The generator's AC output comes from the stator windings which also supply 120 volts to the static exciter. This 120 volts is from either a 120 volt winding or a special 120 volt tap on high voltage winding (480 volt). An additional stator winding supplies power for the plant's battery charging system.

To aid aervicing and repair, all output leads from the generator and connections to the exciter are marked. The lead and terminal markings are shown on the plant wiring diagram.

Magneciter is the trade name of Onan's static exciter system. It has no moving parts and usea magnetic amplifiers and rectifiers to supply direct current to the alternator'a revolving field and to regulate the AC output.

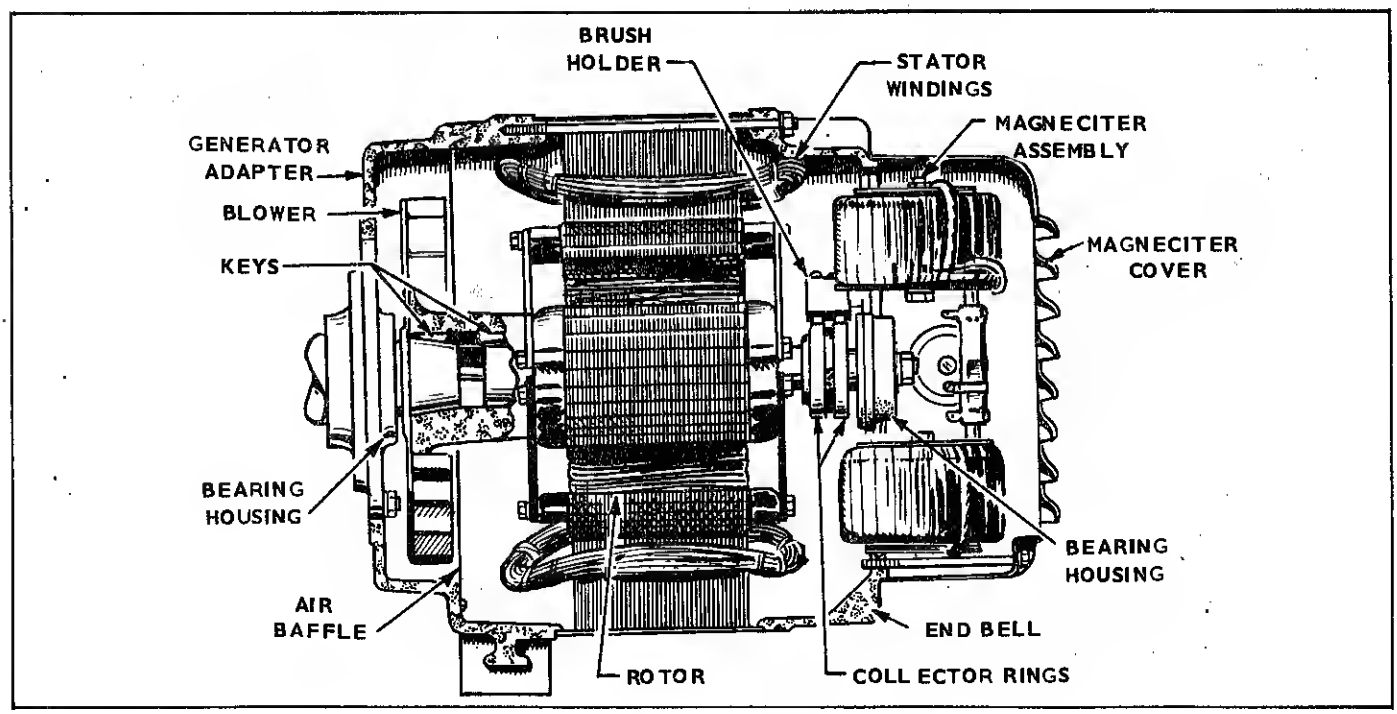


FIGURE 77. AC GENERATOR

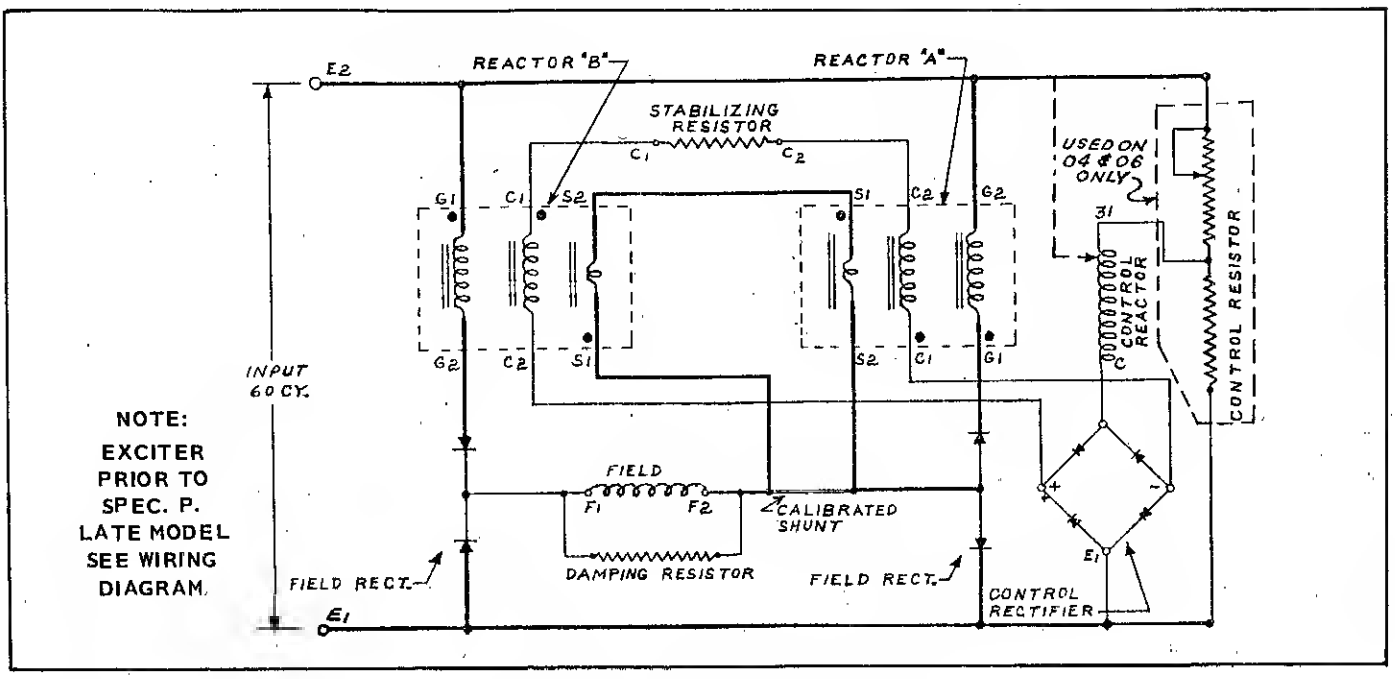


FIGURE 78. EXCITER PRIOR TO SPEC P

OUTPUT VOLTAGE ADJUSTMENT

Controls in the magneciter allow small changes in the generator output voltage. DON'T use these controls to increase generator output above the rated voltage (i.e. 120 V, 240 V).

On models with an 02SX Magneciter, adjust the voltage by changing the tap used on the control reactor, C1, C2, or C3. The voltage difference between each of the taps is about 4% of the output voltage and C1 gives the highest voltage. At the factory, the connection was made to C2.

On the 04SX and 06SX Magneciter, an adjustable tapped resistor controls the voltage output. It is adjustable over a range of about 5 percent with the highest voltage when the tap is moved to the top of the resistor. lowest

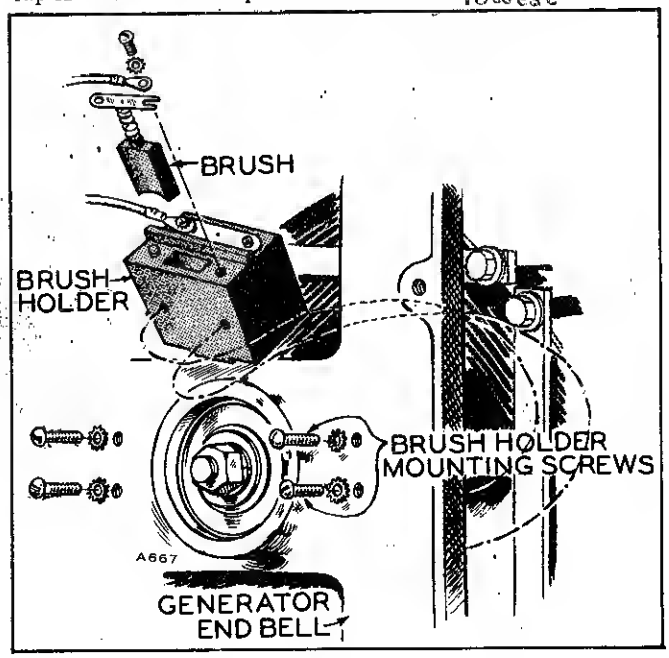


FIGURE 79. BRUSH REMOVAL

MAINTENANCE

The generator normally needs little care other than periodic inspection of the exciter, ballbearing, collector rings and brushes every 1000 hours. However, 02SX exciters require build-up relay cleaning every 500 hours.

BRUSHES

To examine the brushes, brush springs and slip rings, remove the exciter cover at the rear end of the generator. The exciter mounts on a hinged plate. Remove the screws from the right side of the plate and swing the assembly outward. To remove the brush holders, unscrew the four machine screws on the endbell near the ballbearing (Fig. 79.)

Replace the brushes when they wear to about 5/16" long. Don't use a substitute brush that may look identical. It might have entirely different electrical characteristics.

GENERATOR BEARING

The generator ballbearing is prelubricated and doublesealed. Inspect every 1000 hours with the plant running.

If the plant is used for "standby power", replace bearing every five years. If used as "prime power", replace bearing every 10,000 hours or two years. Deterioration of the bearing grease due to oxidation makes this replacement necessary.

If the bearing becomes noisy, worn or otherwise defective, replace it. Remove the old ballbearing with a gear puller and press a new one into place. See Fig. 80.

COLLECTOR RINGS

The collector rings must be clean and free of burrs, scratches and marks. If necessary, use No. 00 sandpaper to clean the surface. Never use emery cloth or other conducting abrasives.

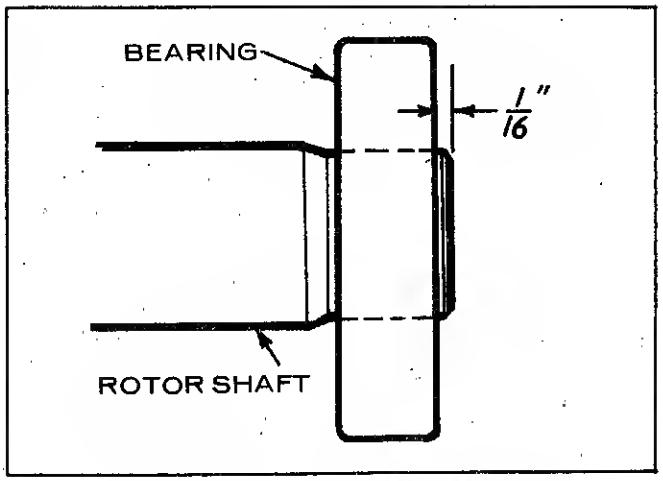


FIGURE 80. INSTALLING BALL BEARING

Collector rings may have a dark brown or black appearance. This is a thin lubricating film and aids the life of the brushes and slip rings. (Do not remove film.)

If the collector rings are grooved, out-of-round, pitted or rough so that good brush seating can't be maintained, remove the rotor and refinish the rings in a lathe. Remove or shield the ballbearing during refinishing. The collector rings should have a Total Indicated Reading (T.I.R.) of .002".

EXCITER

The exciter contains no moving parts except for the 02SX. Periodically blow out any dust and make certain that all componenta and connections are aecure.

A buildup relay was used on the 02SX models. Early models had open relays and later model relays were enclosed in metal shields. The relay contacts should be cleaned regularly. Carefully wipe the relay contacts with paper to remove any non-conducting film or dirt.

TESTING AND REPAIR

If repair work is necessary on the generator, it should be performed by a competent electrician who is familiar with operation of electric generating equipment.

TROUBLESHOOTING

In the event of abnormal generator output voltage, observe the following procedures.

No Voltage Buildup: Remove the exciter cover and with the plant running, operate the residual reset button on the Magneciter.

NOTE: *Early 04SX and 06SX models had no reset button. On reset button. On these models place jumpers momentarily from G1 to G2 of each reactor simultaneously with the plant running. On the 02SX exciter, the buildup relay automatically performs this function. Plants beginning Spec P have a voltage tap at terminal 35 which allows automatic field flashing during plant cranking to assure voltage buildup.*

If output voltage won't buildup after pushing the reset button, flash the field (Fig. 81). Connect a voltmeter across the AC output. Then run the plant and momentarily touch the leads of a six volt lantern battery to the exciter to brush leads ... positive (+) to F1 and negative (–) to F2.

While viewing the voltmeter:

1. If voltage builds up to normal, trouble was due to lost residual in the field.
2. If voltage is low, the Magneciter is probably defective. (See Magneciter Troubleshooting Chart.)
3. If there is no voltage output with battery connected to F1 and F2, trouble is in alternator.

Over-Voltage or Fluctuating Voltage: If the engine is operating at the correct speed, see Magneciter Troubleshooting Chart.

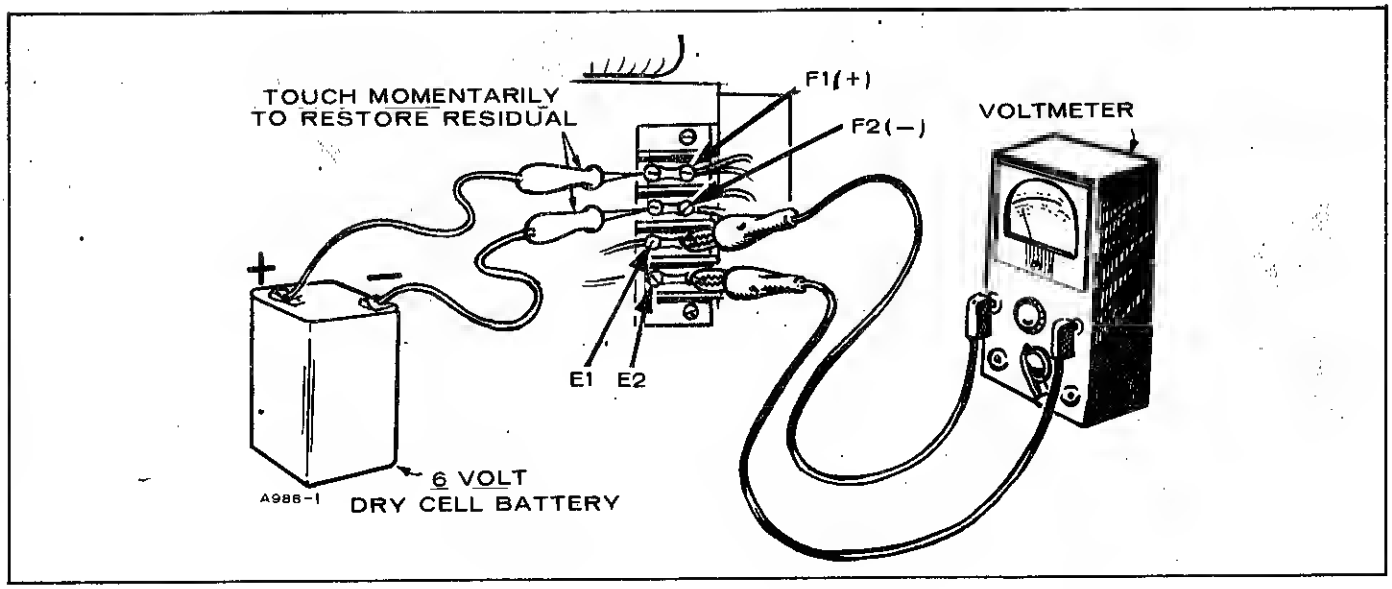


FIGURE 81. FLASHING THE FIELD

ALTERNATOR TESTING

Most alternator testing can be performed without disassembling the generator.

Test Rotor Continuity As Follows:

Remove the brushes so none touch the collector rings.

1. Using an ohmmeter, test for grounding between each slip ring and the rotor shaft.
2. Test for a short or open circuit in rotor winding, by measuring resistance of winding. It should measure between 3.5 and 4.8 ohms for the JB and between 2 and 3 ohms for the JC (at 70°F). If an accurate ohmmeter isn't available, check the rotor for open circuit or grounding with an AC test lamp (Fig. 82). Replace the rotor if it is grounded, or has an open circuit or short.

Test Stotor Continuity As Follows:

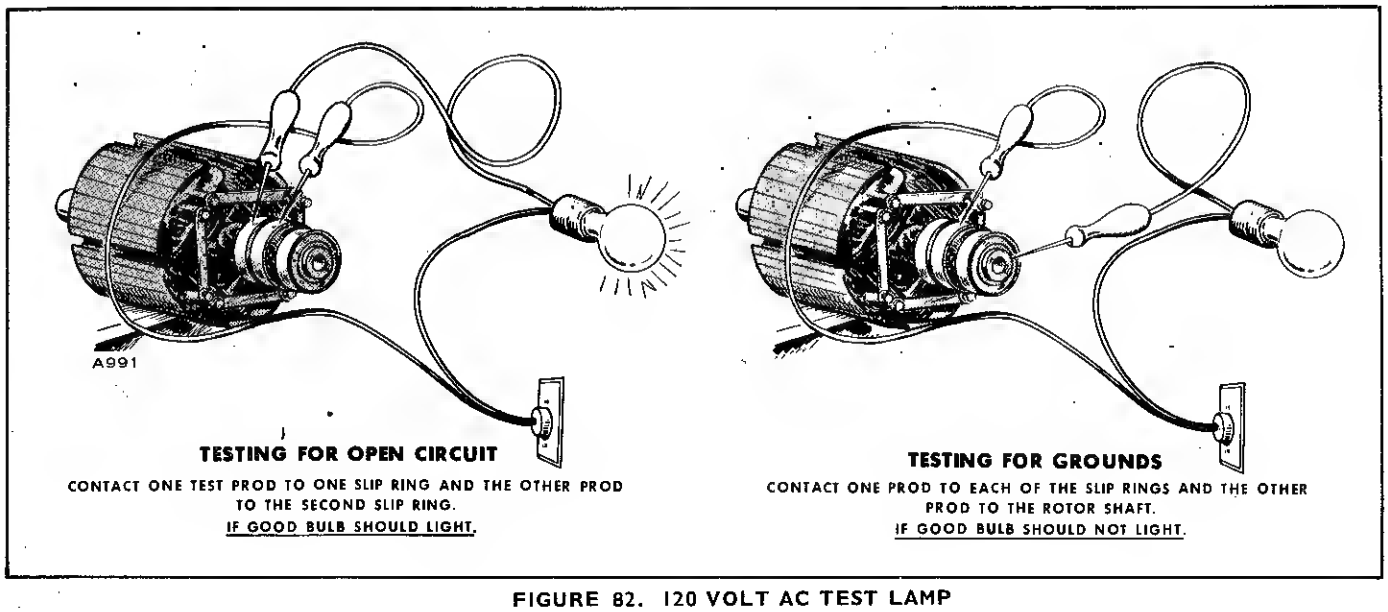
1. Disconnect the generator output leads in the control box. Use the wiring diagrams to determine the output leads in the control box. Use the wiring diagrams to determine the output lead coding. Using either the test lamp or an ohmmeter, check each winding of the stator for grounding to the laminations or frame.

   NOTE: *Some generators have ground connections to the frame. Check the wiring diagrams.*
2. Using an accurate ohmmeter, test the resistance of each stator winding. Compare the resistances obtained. All windings of equal output voltage should indicate about the same resistance. An unuaually low reading indicatea a short; a high reading an open circuit. If the ohmmeter required for this test isn't available, check for open circuits with the test lamp.
3. If any windings are shorted, open-circuited or grounded, replace the stator assembly. Before replacing the assembly, check the leads for broken wires or insulation and replace any defective lead. If this does not correct the fault, replace the assembly. Only a competent rewinding shop should attempt to rewind a defective stator.

Battery Chorging Winding Tests: Remove the lead from the battery polarity reconnection block to ammeter at the ammeter. Install a DC voltmeter between the lead and ground. At governed engine speed, the average DC output should be 19 to 21 volts. If the output is defective, test for open circuit or grounding in the leads and windings. If leads are defective, replace them. If the winding is defective, replace the stator.

TABLE 5. RESISTANCE VALUES

MODEL OF MAGNECITER	CONTROL REACTOR		LARGE REACTOR		BUILD-UP RELAY COIL
	C to 31	C to 1	C1 to C2	G1 to G2	
02SXINIA		14.0	S.0	1.0	52S ± 50
04SXINIA 04SXINIB, 3B	12.5		11.0	1.77	None
065XINIA 06SXINIB, 3B	12.5		5.S	.66	None



TESTING FOR OPEN CIRCUIT

CONTACT ONE TEST PROD TO ONE SLIP RING AND THE OTHER PROD TO THE SECOND SLIP RING.
IF GOOD BULB SHOULD LIGHT.

TESTING FOR GROUNDS

CONTACT ONE PROD TO EACH OF THE SLIP RINGS AND THE OTHER PROD TO THE ROTOR SHAFT.
IF GOOD BULB SHOULD NOT LIGHT.

FIGURE 82. 120 VOLT AC TEST LAMP

EXCITER TROUBLESHOOTING CHART

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	STEP
Generator will not build up voltage.	Circuit breaker in "off" or "tripped" position.	Reset and close breaker.	None
	Open in circuit breaker.	Stop plant and check breaker continuity.	None
	No AC power to Magneciter.	Check AC voltage at E1-E2 with the plant operating. Voltage should be 5 percent of the rated voltage. If not, check continuity from E1-E2 back to generator.	None
	Partial loss of residual in rotor.	With plant operating, jumper from E2 to heat sink of field rectifier Z until voltage begins to build up. Then remove.	None
	Pair of field rectifiers open (either W and Z or X and Y).	Test rectifiers and replace if defective.	(1)
	Both field rectifiers X and Y shorted.	Test rectifiers and replace if defective.	(1)
Output voltage slow to build up. Circuit breaker opens in about 5 seconds.	Either field rectifier X or Y shorted.	Test rectifiers and replace if defective.	(1)
Output voltage slow to build up and 5 percent below rated voltage after build up. Voltage regulation poor.	Either field rectifier W or Z shorted.	Test rectifiers and replace if defective.	(1)
Output voltage slow to build up and higher than rated voltage after build up.	Open circuit in one or more control rectifier.	Test rectifiers and replace if defective. Check soldered connections to rectifiers.	(1)
Output voltage slow to build up and 10 to 20 percent above rated voltage after build up.	Open in one field rectifier.	Test rectifiers and replace if defective.	(1)
	Open circuit in gate winding G1-G2 of reactor A or B.	If field rectifiers Y and Z check okay, check continuities of gate windings G1-G2.	(2)
Output voltage builds up normally but less than rated voltage after build up.	Shorted winding in control reactor.	Test control reactor and replace if defective.	(3)
Output voltage builds up normally with slightly less than rated voltage at no load and low voltage at full load.	Compound winding S1-S2 installed backward or has open circuit.	Check wiring diagram for polarity of compound windings through reactors A and B and test for continuity.	None
Output voltage builds up normally but 20 percent above rated voltage after build up. Voltage regulation poor.	Compound winding S1-S2 installed backward through one reactor (A or B).	Check wiring diagram for polarity of compound winding through reactor A or B.	None
Output voltage builds up normally but is 25 percent above rated voltage after build up.	Open circuit in control rectifier bridge.	Check continuity from the junction of control rectifiers Z and Y to the junction of control rectifiers X and W.	None
Output voltage builds up normally but 125 to 150 percent above rated voltage after build up.	Shorted turn in gate winding G1-G2 of reactor A or B.	Test reactors A and B for shorted turns and replace if defective	(2)
Output voltage builds up normally but 150 to 200 percent above rated voltage after build up. No regulation possible.	Control winding C1-C2 or reactor A or B polarized incorrectly.	Check circuit connections of both reactors A and B.	None
	Shorted turn in control winding C1-C2 or reactor A or B.	Test reactors A and B for shorted turn and replace if defective.	(2)
	Open in control circuit.	Check continuity from E1-E2 through control circuit.	None
Generator voltage fluctuating while engine running at constant speed.	Incorrect setting on stabilizing resistor.	Check resistance and reset.	(4)

For corrective steps, see following page.

STEP 1 – CHECKING RECTIFIERS

Disconnect one lead from, or remove, each rectifier for its individual test.

CAUTION *Note carefully the direction of mounting of any rectifier removed. It must be remounted in its original direction.*

a. Connect the ohmmeter across the rectifier contacts and observe the meter reading.
b. Reverse the connections and compare the new reading with the first reading.
c. If one reading is considerably higher than the other reading, the rectifier can be considered satisfactory. However, if both readings are low, or if both indicate an "open" circuit, replace the rectifier with a new identical part.

STEP 2 – CHECKING REACTORS "A" and "B"

CAUTION *Use an accurate ohmmeter when checking resistance values. Resistance readings between "G" and "G2" cannot be read with accuracy on the multimeter.*

a. Set the resistance range selector on the meter to the resistance range.
b. Isolate one gate winding by disconnecting either end of gate winding G1-G2 from its point of connection; for example, disconnect G1 at E2. Measure the resistance in the gate winding across G1-G2. Refer to Table 5.
c. Isolate one control winding by disconnecting either lead C1 or C2 from the terminal block. Measure the resistance in the control winding across C1-C2. Refer to Table 5.
d. Connect one meter lead to the disconnected gate winding lead and the other meter lead to the disconnected control winding lead and check for continuity.

Results:

1. REACTOR IS SERVICABLE if resistance is within 20 percent either way of the value listed and there is no continuity between the control and gate windings.
2. REACTOR IS DEFECTIVE if there is an open circuit in either the gate or the control windings. Continuity between the gate and the control windings is also an indication of a defective reactor. In either case, the reactor should be replaced.

STEP 3 – CHECKING CONTROL REACTOR

a. Isolate the control reactor by disconnecting common lead "C" from its point of connection and carefully measure the resistance from this lead to the number lead on the control reactor. Refer to Table 5.

Results:

1. CONTROL REACTOR IS SERVICEABLE if resistance is within 10 percent of the value specified.
2. CONTROL REACTOR IS DEFECTIVE if no continuity is indicated between the common lead "C" and the numbered lead, indicating the presence of an open circuit.

STEP 4 – CHECKING RESISTORS

The reaistors must be checked with a multimeter adjusted to appropriate range of resiatances. See wiring diagram for correct values.

Results:

1. RESISTOR IS SERVICEABLE if thc measured resistance falls within 20 percent of the value specified in the wiring diagram.
2. RESISTOR IS DEFECTIVE if there is indication of continuity through the resistor. If the measured resistance exceeds the percent limita either way, the stabilizing resistor can be adjusted to bring the resistance within the required limits.

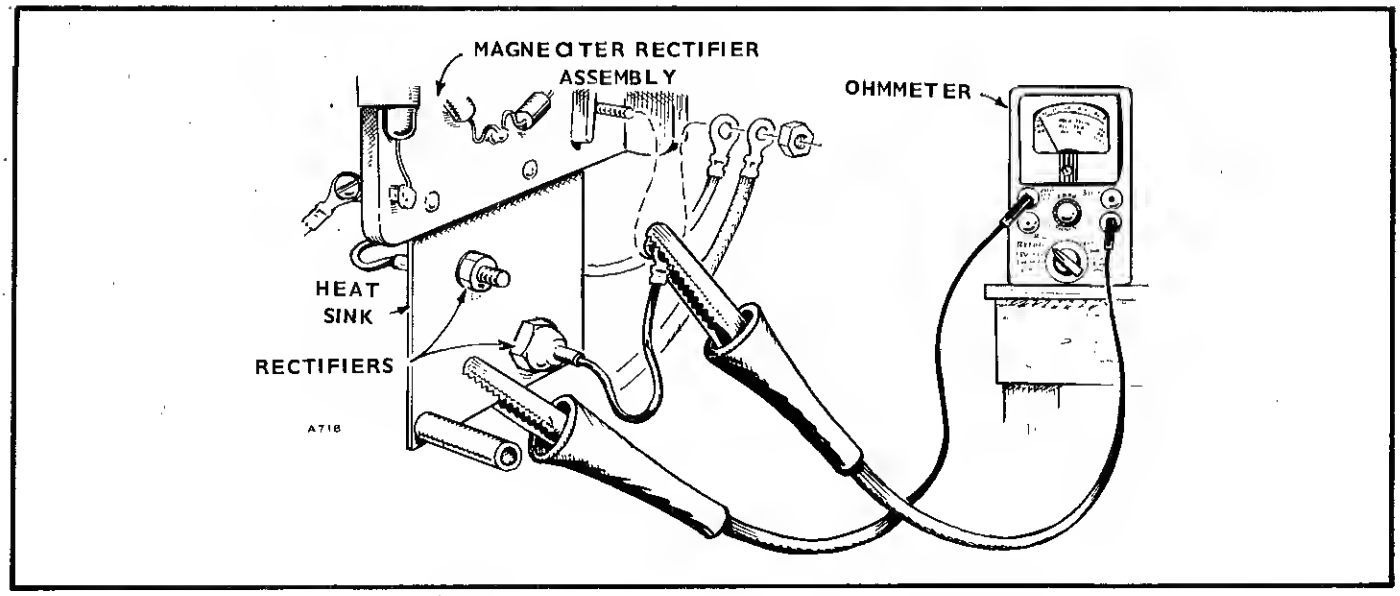


FIGURE 83. CHECKING RECTIFIERS WITH OHMMETER

GENERATOR DISASSEMBLY

1. Disconnect the battery to prevent accidental starting of the plant.
2. Remove the exciter cover and open the exciter. This will reveal the rotor-thru-stud nut.
3. Remove the four machine screws on the end bell near the bearing and lift out the brush holders. (Fig. 79).
4. Remove the lead from the tapped adjustable resistor in the generator air outlet opening.
5. Remove the leads from the control box to the ignition system choke, start disconnect switch, etc. on the engine.
6. Remove generator-through-stud nuts, remove the end bell and stator assembly. Screwdriver slots in the adapter provide a means for prying the stator loose. Be careful not to let the stator touch or drag on the rotor.
7. Remove baffle ring from adapter. Turn rotor-through-stud nut to the end of the through stud. While pulling the rotor outward with one hand, strike a sharp blow to the nut (in the direction of the through stud, **Not Vertically**) with a heavy, soft faced hammer to loosen the rotor from its tapered shaft fit. If the rotor does not come loose, strike it with a sharp downward blow in the center of the lamination stack with a lead or plastic hammer. Rotate the rotor and repeat until it comes loose. Be careful not to hit the collector rings, bearing or windings.
8. After disassembly, all parts should be wiped clean and visually inspected.

GENERATOR ASSEMBLY

1. Clean and inspect all mating surfaces.
2. Coat the mating area between the generator shaft and the engine crankshaft with a thin film of lubricating oil, "Moly Coat" or equal.
3. Install the rotor-through-stud in the engine crankshaft.
4. Install the key in the crankshaft.
5. Slide the rotor over the through-stud and onto the crankshaft. Be careful not to let the weight of the rotor rest on the through-stud.
6. Install the baffle ring.
7. Install generator through studs in the adapter.
8. Install the stator and bearing support (end bell). Tighten the nuts on through-studs.

   NOTE: *Make certain the B1 lead is placed through the grommet in the baffle ring and out the air discharge opening in the adapter.*
9. Now torque down the rotor-through-stud nut (55-60 ft. lb.). Because the stator and bearing support were tightened before tightening the rotor, the rotor and stator are automatically aligned.
10. Tap the bearing support to the horizontal and vertical plane with a lead hammer to relieve stresses on the components (recheck torque).
11. Reconnect the leads to the preheater, centrifugal switch and governor solenoid.
12. Install lead B1 on the adjustable resistor.

    CAUTION *Check this lead to see that it is short and is kept away from the blower. If necessary when installing a new stator or leads, cut it shorter and reinstall the connector.*
13. Install the brushes and brush holders.
14. Close the Magneciter, secure with four capscrews and install the end cover.

REVOLVING ARMATURE GENERATOR

The revolving armature used on 4.0JB, 5.0JB, 7.6JB and 60 cycle 6.0JB planta is a 4 pole, self-excited generator with inherent regulation. The generator serves as a starting motor and furnishes DC current to recharge the batteries during operation.

The generator field contains shunt windings and seriea windings (a few turns of heavy wire wound on the same forms as the shunt windings). The series windings act as the starting motor field. The shunt windings produce the magnetic field in which the armature turns to produce useful output.

The generator's armature contains both AC output windings and DC windings to supply the field and battery charging circuit.

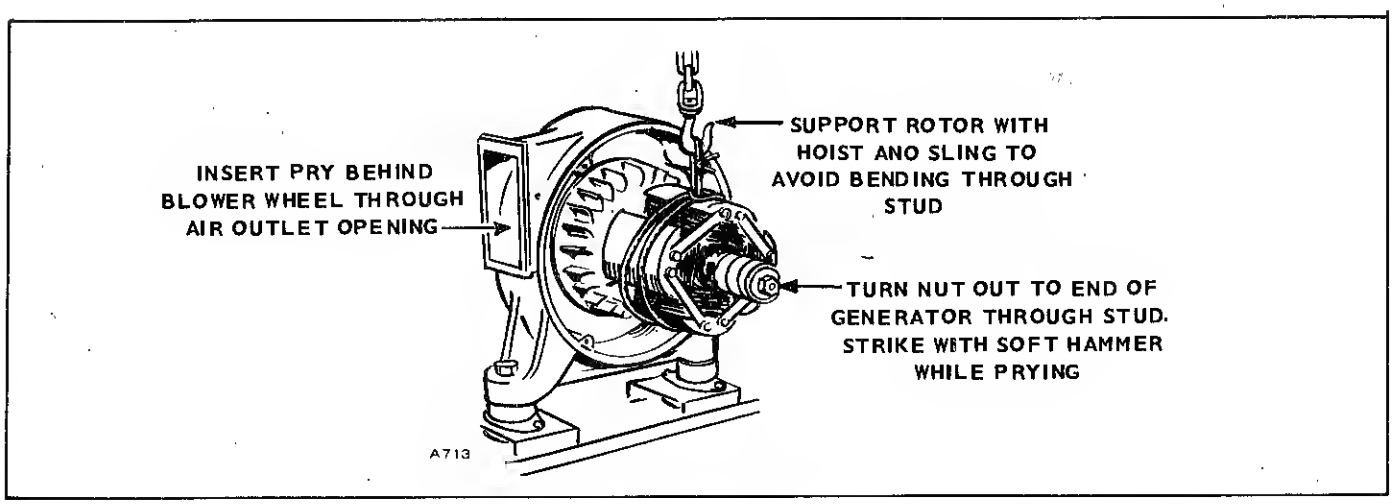


FIGURE 84. GENERATOR DISASSEMBLY

The generator is mounted to the engine through the engine-to-generator adapter and the armature is directly connected (a tapered fit) to the crankshaft. The outboard end of the generator rides on a ball bearing housed in the endbell. Because of its construction, the generator can't be removed as a unit.

Generator leads are marked with metal tags for identification. Lead and terminal marking codes are noted on the plant wiring diagrams.

MAINTENANCE

Normal maintenance includes periodic inspection of the armature, ball bearing, collector rings and commutator, and the brushes normally every 500 hours. Also, blow the generator clean with compressed air every 1000 hours.

BRUSHES

Remove the endbell band and cover and check the brushes. Replace brushes when they wear to about 5/8" long. All brushes must have at least a 50 percent seat. Seat the brushes by sanding (see Fig. 86).

ADJUSTMENTS

The engine governor controls generator output frequency. Engine speed determines generator output voltage. The voltage drop from no load to full load operation is determined by the engine governor sensitivity.

To change output voltage slightly within the range shown in Table 6 adjust the governor. This will also change the plant output frequency. Be sure the frequency stays within the maximum and minimum limits shown in Table 6 for Revolving Armature generators.

Adjust the governor sensitivity to change the voltage drop from no load to full load within the range shown in Table 6.

TESTING AND REPAIR

Most of the following tests can be performed without disassembling the generator.

Armature Testing: Before testing remove all brushes from their holders (Fig. 85).

1. Using a test lamp or ohmmeter, check the AC winding for an open circuit between the slip rings. If an open circuit is found, replace the armature.
2. Test both the slip rings and commutator for grounding to the shaft.

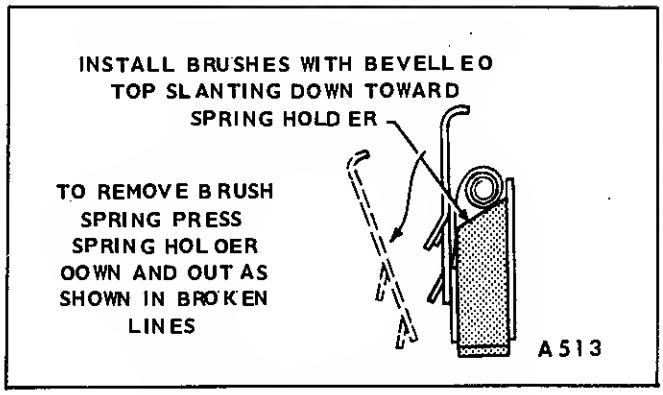


FIGURE 85. BRUSH REMOVAL

If the commutator is grooved, out-of-round, or otherwise damaged, refinish it. Turn it in a lathe and then undercut the mica as described above. Shield the ball bearing during refinishing.

Collector Rings: If the collector rings are grooved, out-of-round or rough so that good brush seating can't be maintained, remove the armature and refinish the rings in a lathe. Shield the ball bearing during refinishing.

Ball Bearing: If the ball bearing becomes noisy, worn or otherwise defective, replace it. Remove the old ball bearing with a gear puller and drive or press a new one into place.

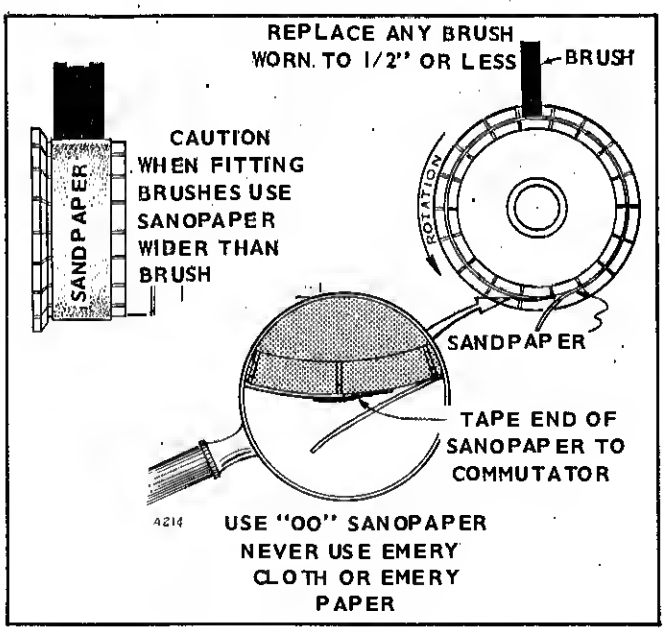


FIGURE 86. COMMUTATOR MAINTENANCE

Nominal Output	Maximum Voltage At No Load	Minimum Voltage At Full Load	Preferred Drop - No Load To Full Load	Maximum Frequency At No Load	Minimum Frequency At Full Load	Preferred Frequency No Load To Full Load
120	126	110	122-114	64 Cycles	57 Cycles	61-59
240	252	228	246-236	64 Cycles	57 Cycles	61-59
120/240	252	228	246-236	64 Cycles	57 Cycles	61-59
120/208	218	198	216-200	64 Cycles	57 Cycles	61-59

TABLE 6.

3. Test the armature for an open circuit in the DC windings by checking continuity between all adjacent bars of the commutator.

   Touch the probes to two adjacent bars and check for continuity. Move each probe over one bar and again check. Continue around the commutator. Any adjacent bars that don't show continuity indicate an open armature winding. Test for shorts in the DC armature winding.

4. This test can only be performed with the generator disassembled and requires a growler. Place the armature in the growler, operate the growler and pass a steel strip back and forth over above the armature windings (Fig. 87). If the strip is magnetically attracted to the armature at any point, a short is indicated. After testing in one position, rotate the armature slightly and repeat the test. Do this for one complete revolution.

   If the test indicates a short circuit in the DC windings be sure the commutator is clean. Carbon dust, dirt and grease between the bars or slip rings could cause a short.

If any of the tests above show that the armature is defective, replace it.

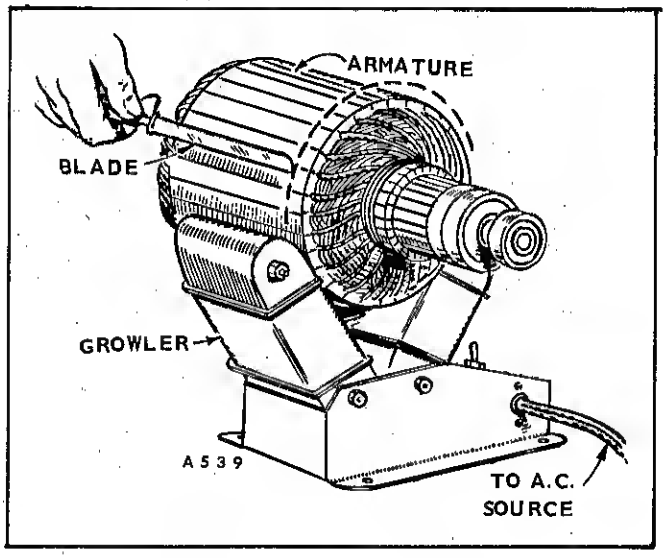


FIGURE 87. CHECKING FOR SHORTS

Field Winding Tests: Perform the following tests without disassembled the generator. The field coil leads must all be disconnected from their terminal points; brush rig, control box, and external connections. If a defective coil is found, disassemble the generator and replace the defective coil.

1. With an ohmmeter or continuity lamp, check for grounding to the generator frame. Touch one prod to each coil terminal in turn and the other to a clean, paint-free part of the frame. If the test indicates grounding, separate the windings and check each.
2. Check the field winding resistance from the negative commutator brushes (from F2 when used) to the F+ connection on the generator (F+ is connected to the positive brushes) with all commutator brushes lifted off their seats. See Resistance Table 7 for correct values. If the windings are warm from running, the resistance will be slightly higher than specified. If the resistance is high, check for an open circuit in one of the parallel windings, step 3, otherwise go directly to step 4.
3. Separate the parallel field windings (at F+) and check each for open circuit.
4. Check for open circuit in the series winding with ohmmeter. Touch probes to lead S1 and connection F+. If there is an open circuit, isolate each coil and check it.
5. Test for short circuit between the starter windings and the shunt windings. Before doing this, separate all windings at F+.

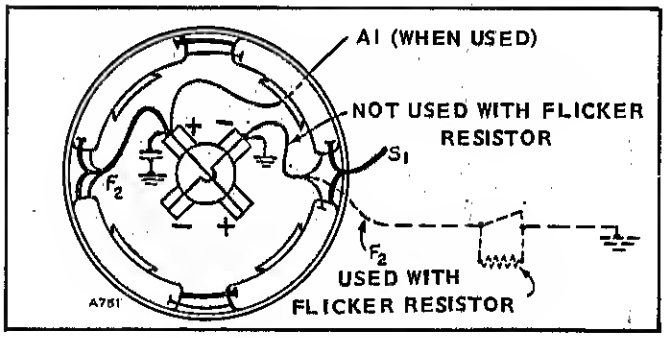


FIGURE 88. FIELD LEADS

Commutator Repair: The commutator bars eventually wear down so the mica between them extends over the tops of the bars and causes sparking and noisy brushes. When the mica on any part of the commutator is touching the brushes it must be undercut. A suitable undercutting tool can be made from a hacksaw blade (Fig. 89). Cut the mica to about 1/32" under the bars. Be careful not to damage the bars. After undercutting, remove any burrs formed on the bars.

TABLE 7.

GENERATOR MODEL	DC VOLTAGE (NO LOAD)	FIELD RESISTANCE	RESISTANCE PER COIL
4.0JB Spec A & B	27 Volts	1.7 Ohms	1.7 Ohms
5.0JB Spec A & B	27 Volts	1.7 Ohms	1.7 Ohms
4.0JB Spec C	31.5 Volts	2.1 Ohms	2.1 Ohms
5.0JB Spec C	31.5 Volts	2.1 Ohms	2.1 Ohms
6.1JB	35.6 Volts	2.4 Ohms	2.4 Ohms
7.6JB	35.6 Volts	2.4 Ohms	2.4 Ohms

NOTE: All Values are based on standard models.

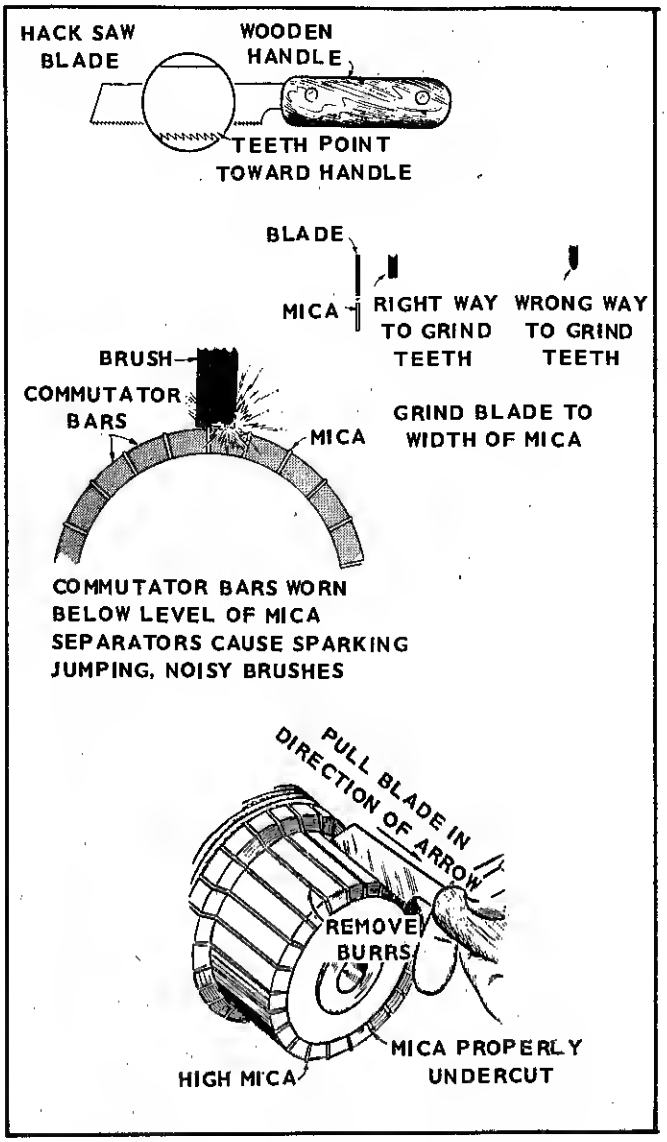


FIGURE 89. CORRECTING HIGH MICA CONDITION

Brush Rig Alignment: Align the brush rig to the neutral position. Normally, the neutral position is identified by a yellow mark extending from the brush rig to the endbell (Fig. 90). If the mark is lost or a new brush rig installed, find the neutral position according to the following instructions:

1. With the generator end cover and band removed to allow access to the rig, connect a voltmeter across the DC terminals.
2. Then start the unit and apply full rated load.
3. Loosen the brush rig mounting screws and rotate the rig to get the highest voltage.
4. Rotate the rig in one direction until the voltmeter reading starts to decrease. Mark this point. Repeat in the other direction.
5. Half the distance between the two marked points is the neutral position.

NOTE: *If a voltmeter isn't available, use the above procedure but mark the point where arcing begins.*

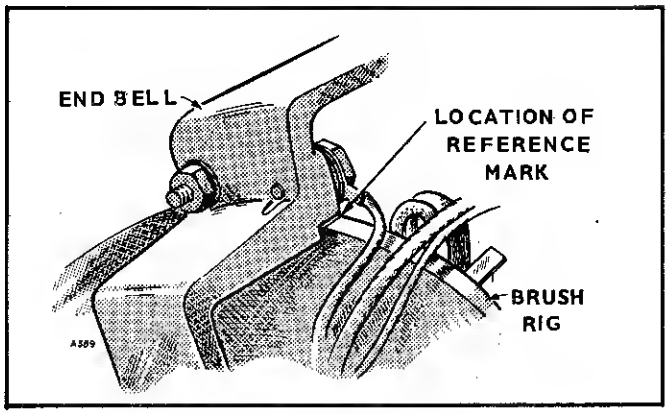


FIGURE 90. BRUSH RIG POSITION

GENERATOR DISASSEMBLY

1. Remove the battery cables, and leads to the engine.
2. Remove the endbell cover and band.
3. Remove the brush springs (Fig. 85).
4. Loosen the thru-armature-stud nut in the center of the rear bearing.
5. Remove the thru-generator-stud nuts on the endbell.
6. Slide the endbell, brush rig and frame off as one assembly. Be careful not to drag the frame on the armature.
7. Remove the screws holding the blower baffle to the engine-to-generator adapter and remove the baffle.
8. Slide the armature and blower assembly off the stud. To loosen the assembly from the crankshaft, tap the threaded end of the stud several times with a soft hammer to avoid damaging the threads.

   NOTE: *If the above procedure doesn't loosen the armature assembly, tap downwards on the outboard end of the armature shaft, rotate it 1/2 turn and repeat. Don't hit the commutator, collector rings or bearing.*
9. If necessary to remove field coils, remove the pole shoes by removing the capscrews holding each to the frame.

GENERATOR ASSEMBLY

1. Reinstall any pole shoes and field coils removed.
2. Install the armature and blower assembly and install the stud nut.
3. Check for armature runout (Fig. 91). Runout should be less than .002".

   Excessive runout may be caused by dirt or a nick on the taper of either the rotor or crankshaft. If not, correct by tapping the high side of the shaft near the ball bearing. Don't hit the ball bearing commutator or collector rings.

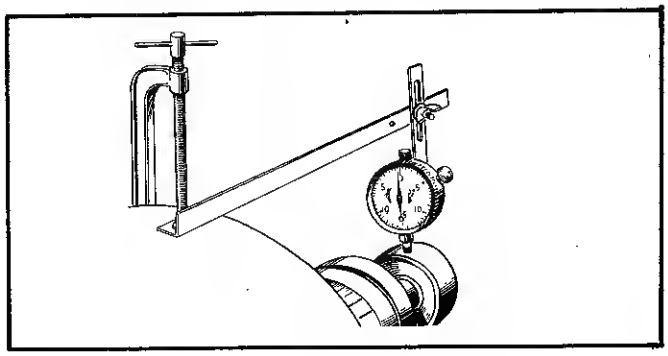


FIGURE 91. ARMATURE RUNOUT

4. Install the blower baffle and secure with screws.
5. Install the bearing stop on the ball bearing.
6. Install the field frame and endbell assembly and secure. Be sure generator output wires feed through the slot in the front of the frame.
7. Tighten the thru armature stud nut to 30-40 lb. ft.
8. Connect leads to the engine. Install the battery cables.
9. Align the brush rig.

CONTROL SYSTEM

The plant control system controls starting, stopping, battery recharging and provides a means of emergency automatic stopping. The control system and control system defects should be analyzed with the aid of the proper wiring diagram.

The views shown (ONAN wiring diagrams) are modified pictorials. Components are shown in their actual positions and normally the top view of each component is shown, for terminal location. Dotted lines show the edges of the control box and indicate the direction from which it is being viewed, i.e. "Top View". All relays are shown in the de-energized position.

Plant control systems are divided into two main types, revolving armature plants and revolving field plants. Each of these types is divided into three different control systems, Manual start (-M), Electric start (-E), and Remote start (-R).

MAINTENANCE

Periodically check all connections and contacts in the control system. Blow out accumulated dust with low pressure air. The breaker point gap of the engine mounted centrifugal switch will have to be checked at regular intervals. This gap should be set at .020".

NOTE: *This switch is not used on exciter-cranked models except with optional low oil pressure cut-off.*

Because of the basic differences between the control system for the exciter-cranked JB and the control system for the starting motor-cranked JB and JC, they are separated.

MANUAL STARTING MODELS (JB-M)

Manual starting models contain no starting motor – they must be started with the crank. These models essentially contain no control system except a stop button.

ELECTRIC STARTING MODELS (JB-E and JC-E)

These models are designed to be started at the plant only. The control starting circuit consists of a heavy duty starting

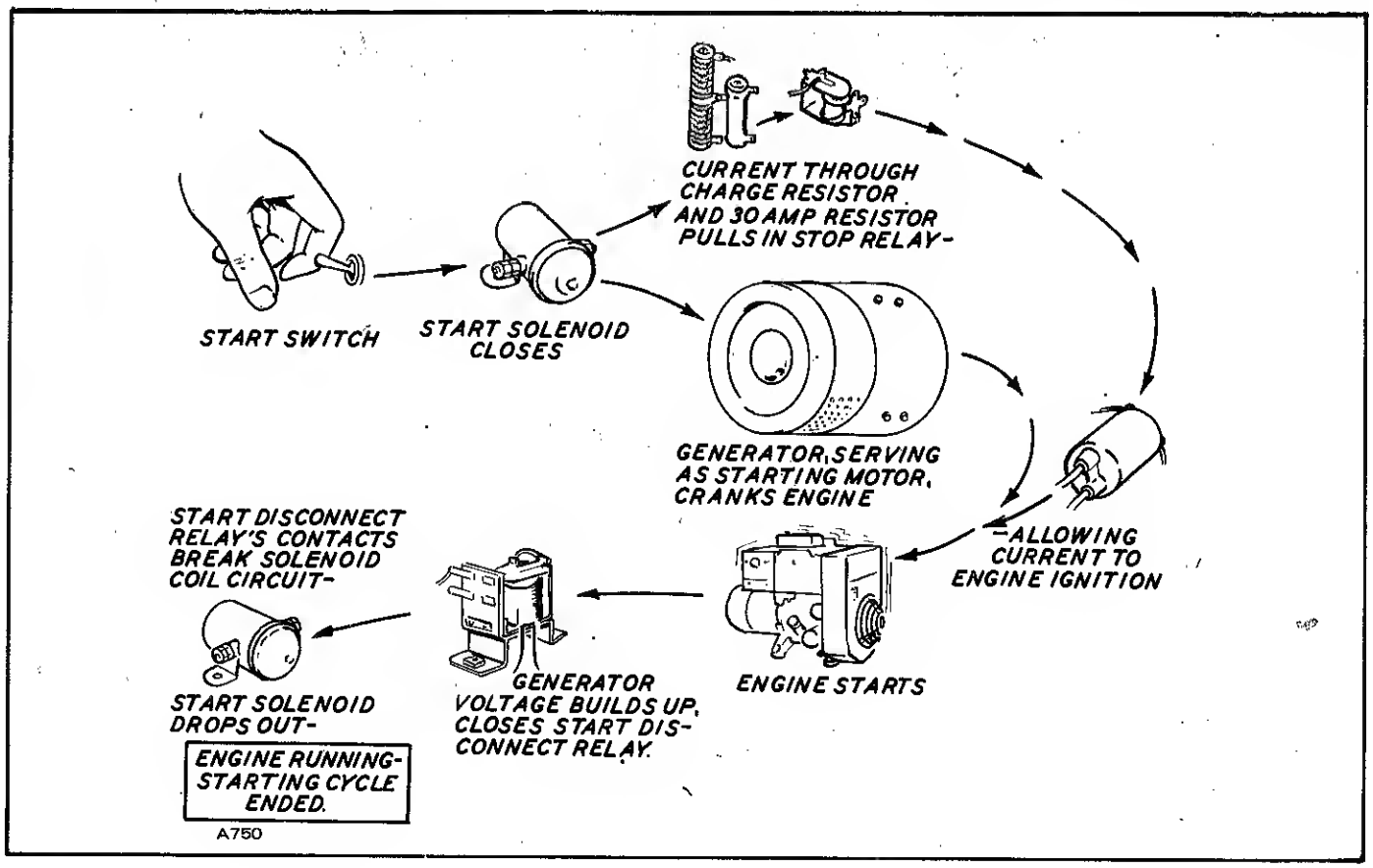


FIGURE 92. STARTING SEQUENCE FOR REVOLVING ARMATURE

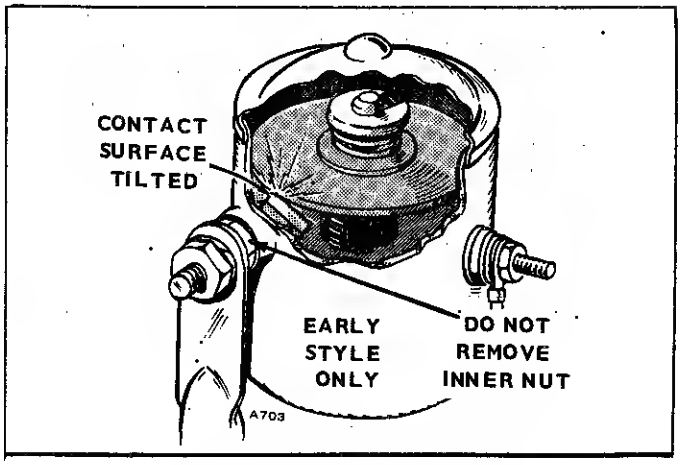


FIGURE 93. START SOLENOID

switch, and the stopping circuit simply of an ignition switch that controls current to the ignition coil. If battery charging or optional emergency shut-off circuits are used, refer to the appropriate sections under remote starting control circuits.

TESTING AND REPAIR-MODELS 4JB-R and 5JB-R.(REV. ARM)

These plants use the generator as a starting motor. The control system includes the starting circuit, a battery charging circuit with reverse current relay and optional high temperature and low oil pressure cut-offs.

If any component of the control system fails, replace it. Normally, relays cannot be repaired.

Starting and Stopping System: The revolving armature starting system includes the start solenoid, stop relay and start-disconnect relay. Fig. 92 shows a starting cycle. To stop the engine, the stop switch grounds the stop relay, breaking the circuit to the ignition coil.

The starting solenoid controls the heavy currents required by the exciter starting motor.

The Stop Relay controls voltage to the ignition coil. When energized it closes the ignition coil circuit. During starting, the stop relay pulls in at the same time as the start solenoid. The generator's DC output maintains it energized throughout operation. To stop, the stop button grounds the relay, which de-energizes, opening the ignition coil circuit.

NOTE: *This is a 6-volt relay and must be used in series with the 30-ohm voltage dropping resistor.*

Check the coil resistance (it should be about 30 ohms), inspect the contacts, and check contact operation when voltage is applied to the coil. If the contacts are dirty, they can be cleaned with hard paper or gauze moistened with carbon tetrachloride.

The Start-Disconnect Relay is energized by the generator DC output, so it pulls in when the output builds up to 10 or 11 volts and remains energized throughout plant operation. When the relay pulls in, it opens the circuit to the start solenoid coil, opening that solenoid to break the starting circuit. To test this relay, inspect the contacts, check the coil resistance (it should be 20 to 24 ohms) and check contact operation when the plant starts.

Battery Charging Circuit: The generator DC windings supply current for the battery charging circuit. The current flows through the reverse current relay, charge ammeter and the adjustable charge rate resistor, located outside the control box.

The battery charge rate can be adjuated between 2 and 5 amps by moving the slider on the charge resistor.

The Reverse Current Relay allows current flow only from the generator to the battery and opens when current attempts to flow in the other direction. To test the relay, isolate it by removing the generator connection (GEN). Check for continuity between the battery and generator terminals. Continuity here indicates that the relay contacts are welded together. Measure the resistance from the generator terminal to ground. This should be approximately 112 ohms.

Automatic Emergency Stopping: The optional emergency stopping system includes two separate devices, the high temperature cut-off and low oil pressure cut-off. Both devices are optional equipment.

NOTE: *When the generating plant is used with Line Transfer or Automatic Demand Controls and one of the emergency stopping devices operates, the plant will stop and then crank until the control's cranking limiter opens.*

This High Temperature Cut-off Switch (Optional) is located in the optional air shutter or air duct. Normally closed, it opens when the air temperature reaches 240°F ±6 and closes again when the temperature drops to 195°F ± 8. The plant cannot be started again until the switch closes.

This Low Oil Pressure Circuit (Optional) includes a non-

adjustable low oil pressure switch and centrifugal switch located on the engine and a latching relay in the control box. The circuit shuts the plant down if oil pressure drops below 7 + 1 psi and prevents it from restarting until the operator pushes a reset button on the control box.

If low oil pressure occurs, tbe pressure switch closes, completing the relay coil circuit. The relay pulls in and latches after 15 to 20 seconds. The centrifugal switcb is required to prevent the circuit from latching during the plant starting cycle, before oil pressure builds up.

TESTING AND REPAIR MODELS: 705JB-R, JC-R and 50-Cycle 6JB (Rev. Field).

The JB revolving field models and JC control systems use a separate starting motor and a rectifier and alternator battery charging system. A separate winding in the generator acts as battery charging alternator. Optional high temperature cut-off and low oil pressure cut-off circuits are available. On the JB and JC an engine mounted centrifugal switch serves as start-disconnect.

If any component of the control circuit fails, replace it. If relay contacts are dirty, they can be cleaned by pulling hard paper or gauze soaked in carbon tetracloride between the contacts.

Starting and Stopping System: The starting aystem includes start ignition relay, ignition relay, atarting solenoid, and the centrifugal switch. It controls the aolenoid-sbift, over-running clutch, starting motor and the ignition coil circuit. Fig. 94 ahows the start cycle. To stop the engine, the stop switch grounds the ignition relay, which opens the circuit to the ignition coil.

The Start Ignition Relay with metal cover, is energized at the beginning of the start cycle by the start switch. It de-energizes when the centrifugal switch closes, completing the starting cycle. Test the relay by checking contact continuity, energized and de-energized, and coil resistance. Coil resistance is about 76 ohms.

The Ignition Relay is normally energized throughout plant operation. It energizes, when the centrifugal switch ending the starting cycle closes, and maintains the current to the engine ignition system. To test the relay, inspect the contacts, check the continuity of each set of contacts, and measure the coil resistance. Coil resistance is about 15 ohms.

CAUTION *This is a 6-volt relay and in the control circuit it is in series with a 15-ohm dropping resistor.*

Tbe Centrifugal Switch is mounted on the gearcover backplate with the ignition breaker points, and operates directly off the camshaft gear. Normally open, the switch closes when engine speed builds up about 900-rpm.

For correct operation, maintain the switch contact gap at .020" (Fig. 95).

Check the contacts for dirt or pitting when adjusting the gap. Clean the contacts with paper or replace it if badly pitted.

In an emergency, if tha centrifugal switch won't operate, the engine can be run by ahorting the awitch leada when the engine starts.

For disassembly and repair of the timing gear and switeh operating mechanism, see Ignition System Section.

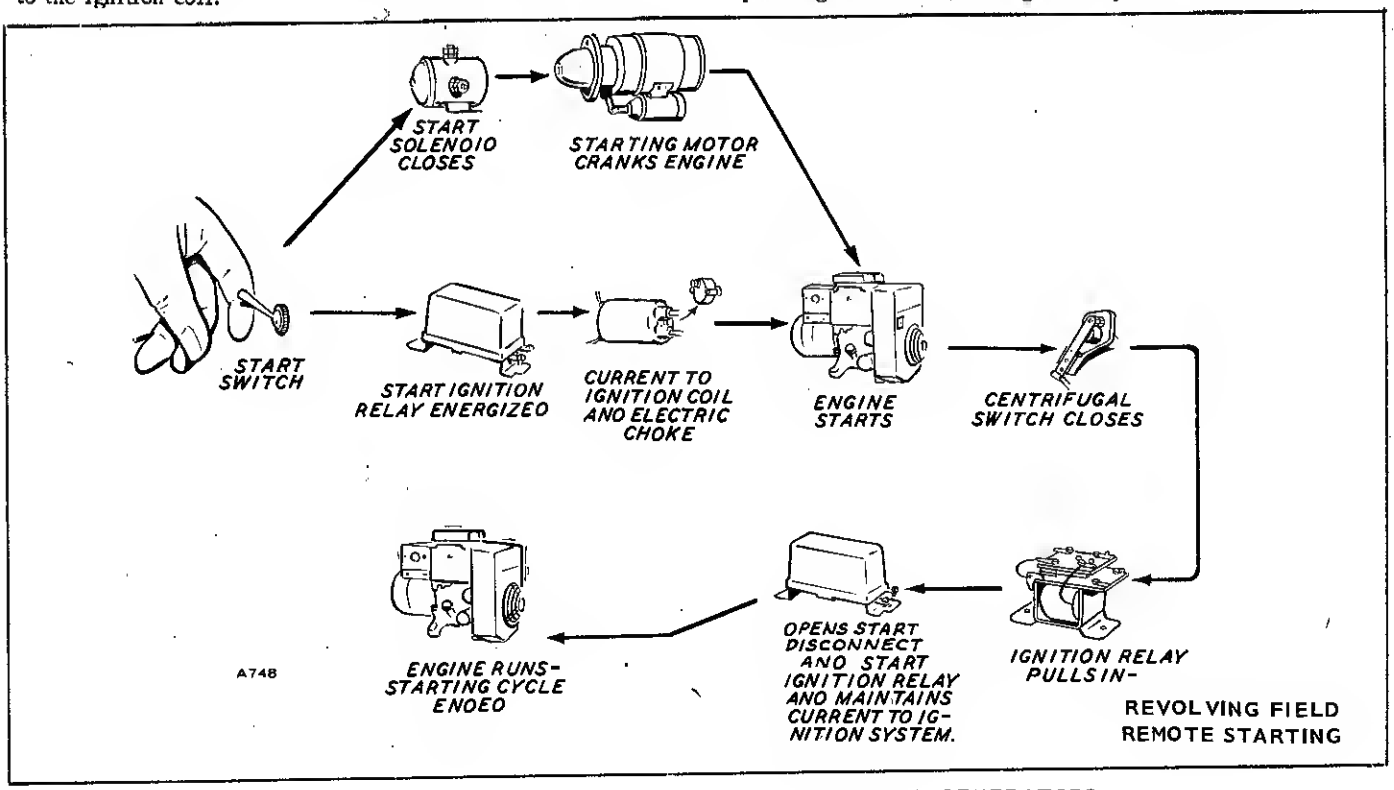


FIGURE 94. STARTING CIRCUIT FOR REVOLVING FIELD GENERATORS

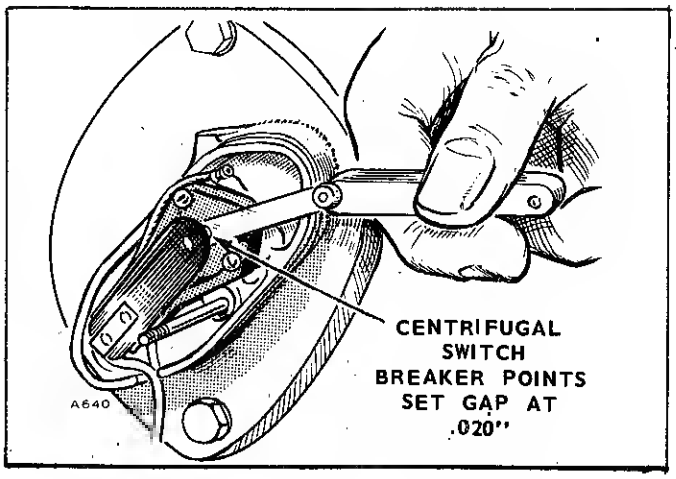


FIGURE 95. CENTRIGUGAL SWITCH

Battery Charging Circuit: This circuit includes the adjustable charge resistor, rectifier, and ammeter. It converts AC current supplied by the generator charging winding to DC and delivers it through the ammeter to the battery. The normal charge rate is about 2 amps and the maximum 5 amps. If any current drawing accessories such as electric fuel pumps are installed, their current draw must be subtracted from the maximum battery charging current and also for the charge rate registered on the plant ammeter. To adjust the charge rate, move the tap on the adjustable resistor in the generator air outlet.

CAUTION *Connecting battery with the wrong polarity will damage the charging circuit within a minute or two. If the adjustable charge resistor is eliminated or shorted, both the circuit and the generator charging winding will be damaged in a few seconds of operation.*

The rectifier converts the AC produced by the generator charging winding to DC and also acts as a reverse current relay. Incorrect battery polarity can destroy the rectifier. If the battery polarity is to be changed, reverse the battery polarity reconnection block in the control box. Polarity reconnection block not used on Spec P and later models or Penn State models.

Important: *If you aren't sure which battery polarity to use, check this block before connecting the batteries.*

WARNING *Spec P models and Penn State models are NEG GROUND ONLY.*

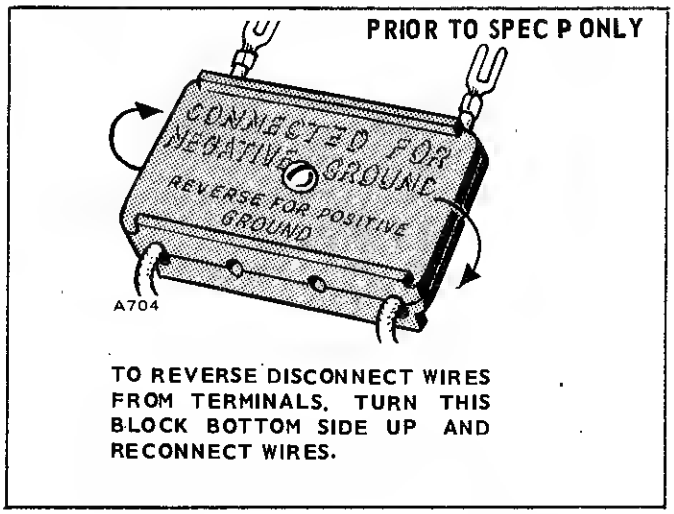


FIGURE 96. BATTERY POLARITY CONNECTION

Test the rectifier with an ohmmeter or 12 volt test lamp. If it is operating correctly, resistance will be very high in one direction and low in other direction.

The Adjustable Resistor is located in the generator blower outlet and has a total resistance of 2 ohms. It includes both a fixed section and an adjustable section. The fixed section determines the maximum charging current and must always be in the circuit to protect the components.

Automatic Emergency Stopping: There are two parts to the emergency automatic stopping system, a high temperature cut-off switch and an optional low pressure cut-off circuit.

NOTE: *When the generating plant is used with Line Transfer or Automatic Demand Control, and one of the emergency stopping devices operates, the plant will stop, and then crank until the control's cranking limiter operates.*

The High Temperature Cut-off (Optional), located in the optional shutter assembly is in series with the ignition circuit. Normally closed, it opens at 240°F ± 6° breaking the circuit to the ignition system, stopping the engine. The switch closes again at about 195°F.

The Low Oil Preasure Circuit (Optional) has a non-adjustable low oil pressure switch. Early model circuits alao have a latching relay and bridge rectifier: later models have an emergency relay. If relay on either model becomes latched, a reset button must be pushed before the plant can be started.

NOTE: *On early models, the low oil pressure circuit may prevent starting after installing new oil filter or after an idle period. Plant will not run long enough to fill filter and build up oil pressure. To avoid this, switch to "manual" for starting.*

Emergency relay on later models allows time for oil pressure build-up.

The Low Oil Pressure Switcb mounts on oil filter adapter. Switch contacts open when plant oil pressure builds up, and close if oil pressure drops below 9 psi on early models and 14 psi on later models. Closed switch contacts energize relay. Test switch by checking continuity with plant stopped and running.

The latching relay (early models) latches in the energized position. Push the reset button to release it. The relay operates when the oil pressure switch closes and energizes Coil A (Fig. 97) which opens the engine ignition circuit and stops the plant. Energizing Coil A allows current flow to Coil B which keeps the relay in a latched position and Coil A de-energizes. Pushing the reset button opens Coil B circuit and the relay unlatches.

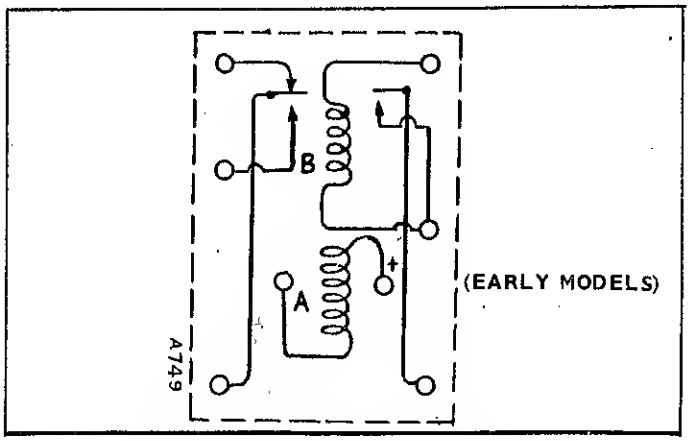


FIGURE 97. EMERGENCY LATCH RELAY

To test relay, operate plant and short oil pressure switch to ground. If relay does not energize and stop plant, check both coils with an ohmmeter for a resistance of 50 ohms each. If it does not latch, check contacts in series with Coil B.

The Emergency Relay (Late Models will operate in 15- to 20-seconds after the oil pressure switch has closed after loss of oil pressure.

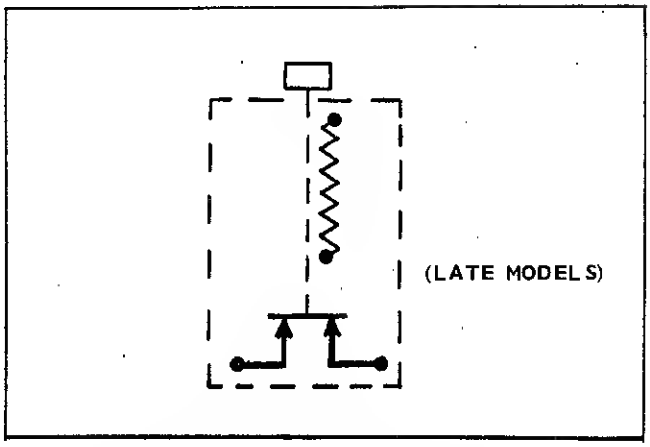


FIGURE 98. EMERGENCY LATCH RELAY

This opens the ignition circuits and stops the plant. To re-start plant wait one minute and push reset button (Fig. 98).

To check relay, energize the heater circuit in series with the 1-ohm resistor from the 12-volt battery. Reset button should pop out in 15-20 seconds.

WIRING DIAGRAMS

The wiring diagrams in this section are typical and apply only to standard electric generating plants. Wiring diagrams for special models are available upon request from the factory. Send complete generator model number, and specification letter with the request.

The first table is for locating wiring connection diagrams for your particular unit; the second table is for locating internal exciter diagrams; the third table is for locating internal control diagrams.

WIRING CONNECTIONS

PHASE	WIRE	VOLTAGE	SPECS INCLUDED	REVOLVING ARMATURE	REVOLVING FIELD	PAGE
1	2	120, 240	A - S	x		70
1	3	120/240	A - S	x		70
1	4	120, 240, 120/240	A - S	x		70
3	4	120/208	A - 5	x		70
3	4	220/380, 277/480, 240/416	A - S	x		71
3	3	240	A - S	x		71
1	4	120, 240, 120/240	A - S		x	72
3	4	120/208, 277/480, 240/416	A - 5		x	72
3	4	120/240	A - 5		x	73

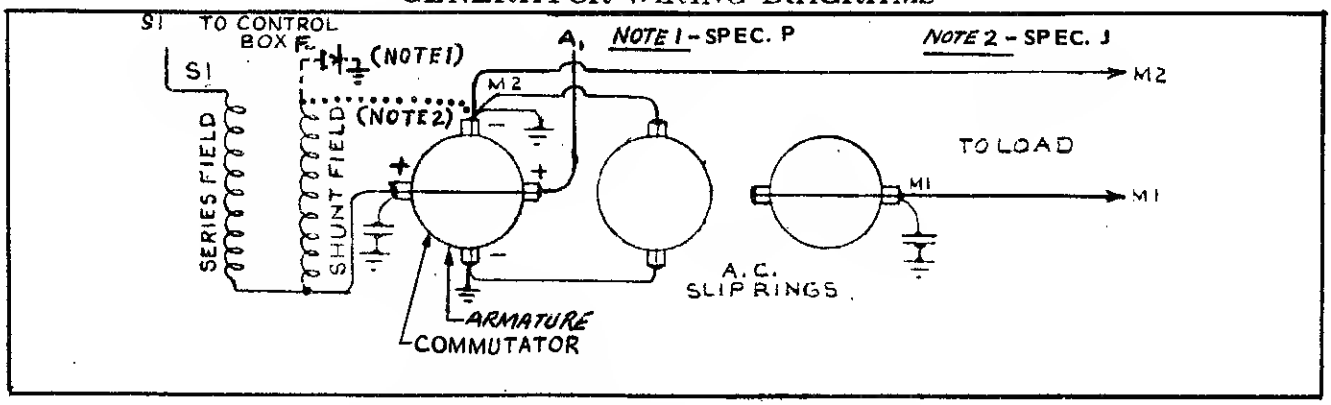
CONTROL CONNECTIONS

PLANT MODELS	SPECS INCLUDED	DIAGRAM NO.	LOW OIL PRESSURE CIRCUIT INCLUDED	PAGE
7.5JB, 60 Cycle; 6.0JB, 50 Cycle	J - M	611C664	NO	78
7.5JB, 60 Cycle; 6.0JB, 50 Cycle	J - M	611C668	YES	77
6.0JB	J - M	611C661	YES	79
6.0JB	J - M	611C656	NO	80
7.5JB, 60 Cycle; 6.0JB, 50 Cycle	P - 5	611C805	YES	81
7.5JB, 60 Cycle; 6.0JB, 50 Cycle	P - S	611C804	NO	82
6.0JB	P - 5	611C797	YES	83
6.0JB	P - S	611C790	NO	84
JC	L	612C2243	YES	85
JC	L	612C2239	NO	86
JC	P - S	612C2658	YES	87
JC	P - S	612C2657	NO	88

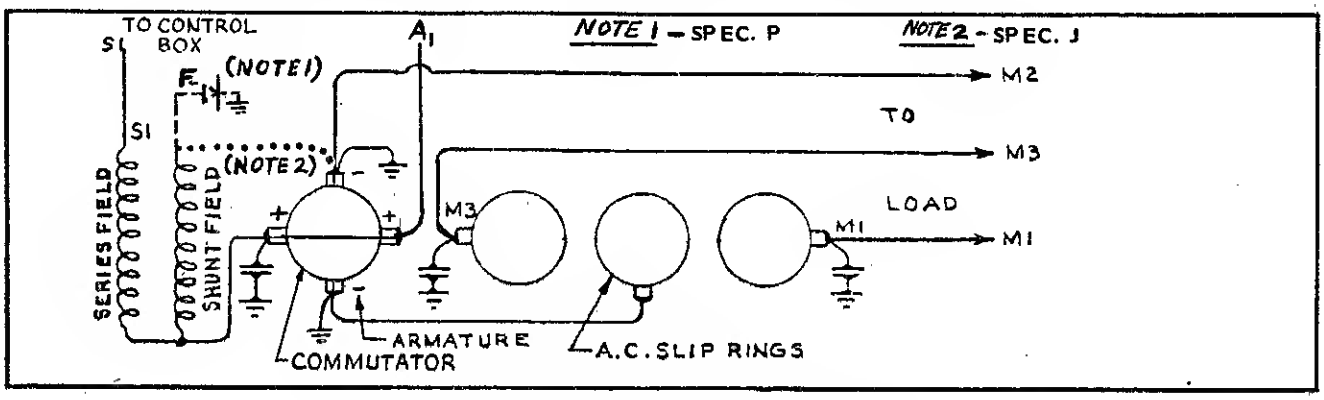
MAGNECITER CONNECTIONS

PLANT SERIES	SPECS INCLUDED	EXCITER NO.	PAGE
JB	C - M	04SXIN1B	74
JB	P - S	04SXIN3B	75
JC	C - L	06SXIN1B	76
JC	P - S	06SXIN3B	76
JC (Penn State Only)	L - S	06SXIN3B	76

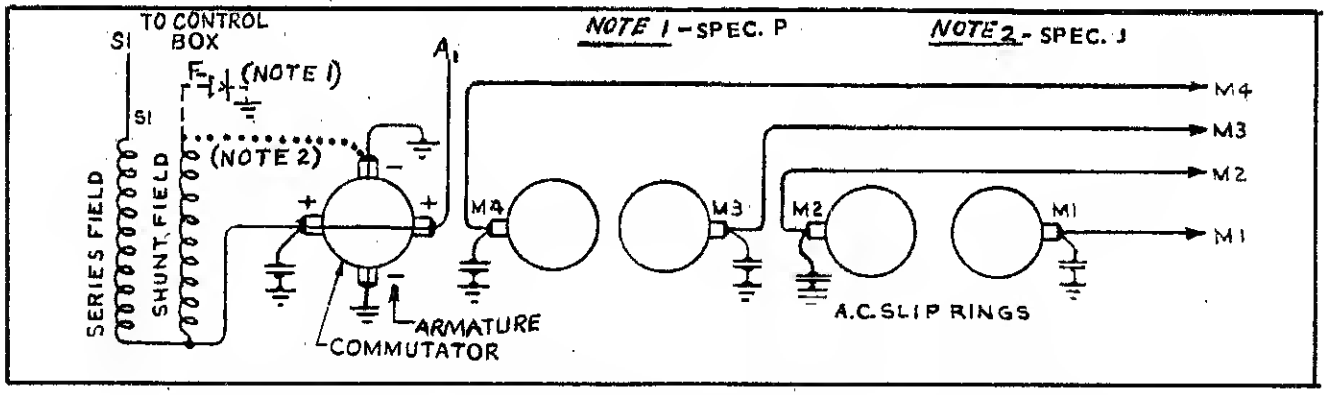
GENERATOR WIRING DIAGRAMS



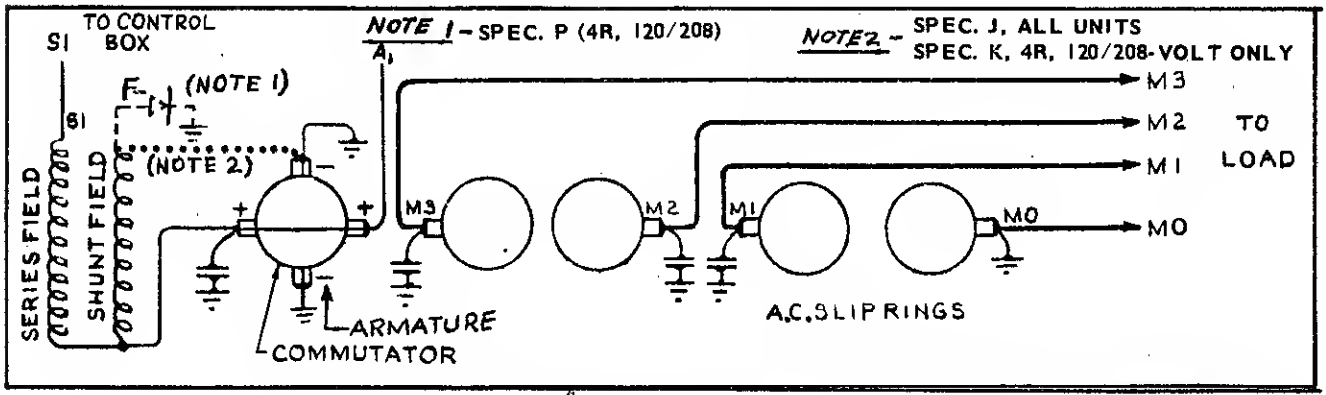
Revolving Armature 2-wire, Single Phase



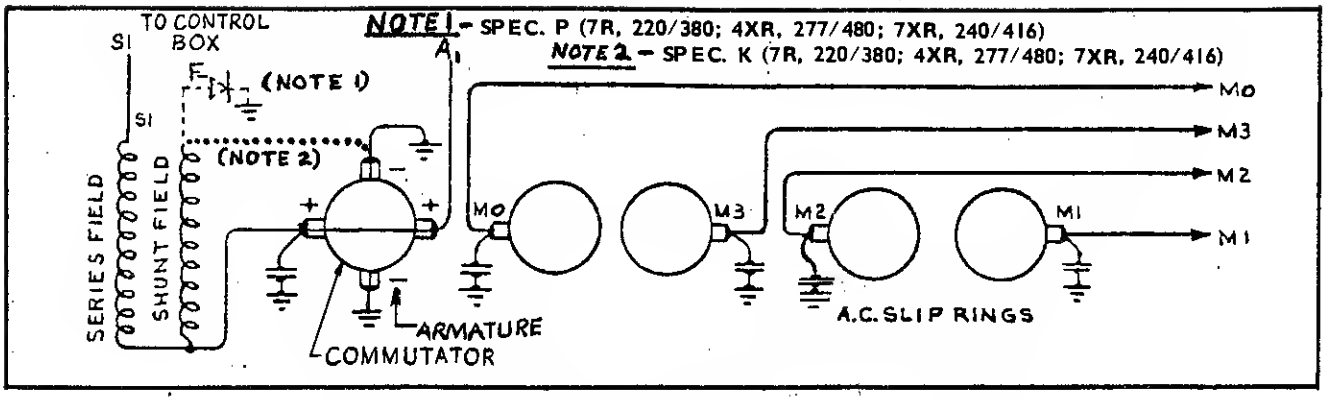
Revolving Armature 3-wire, Single Phase



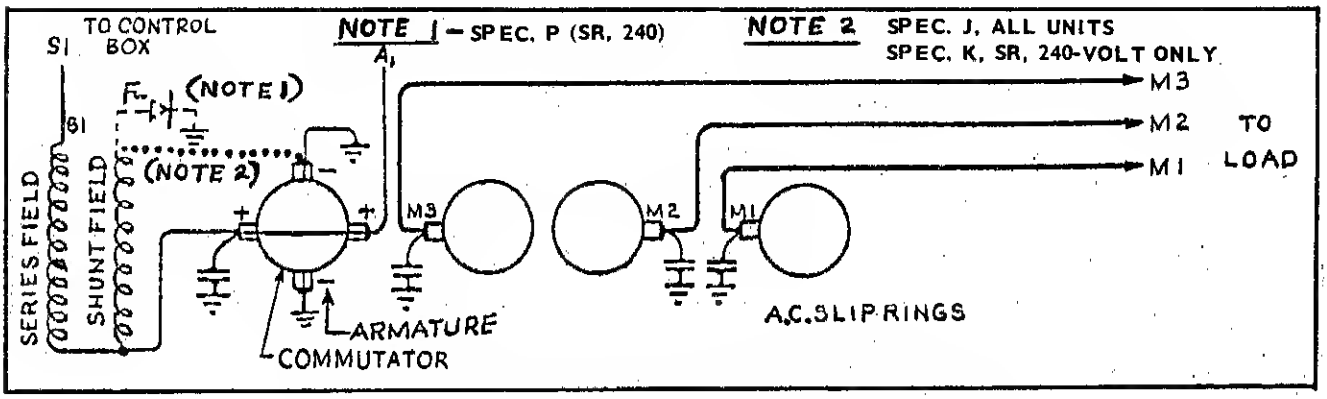
Revolving Armature Reconnectible for 120, 240 or 120-240 Volts, Single Phase



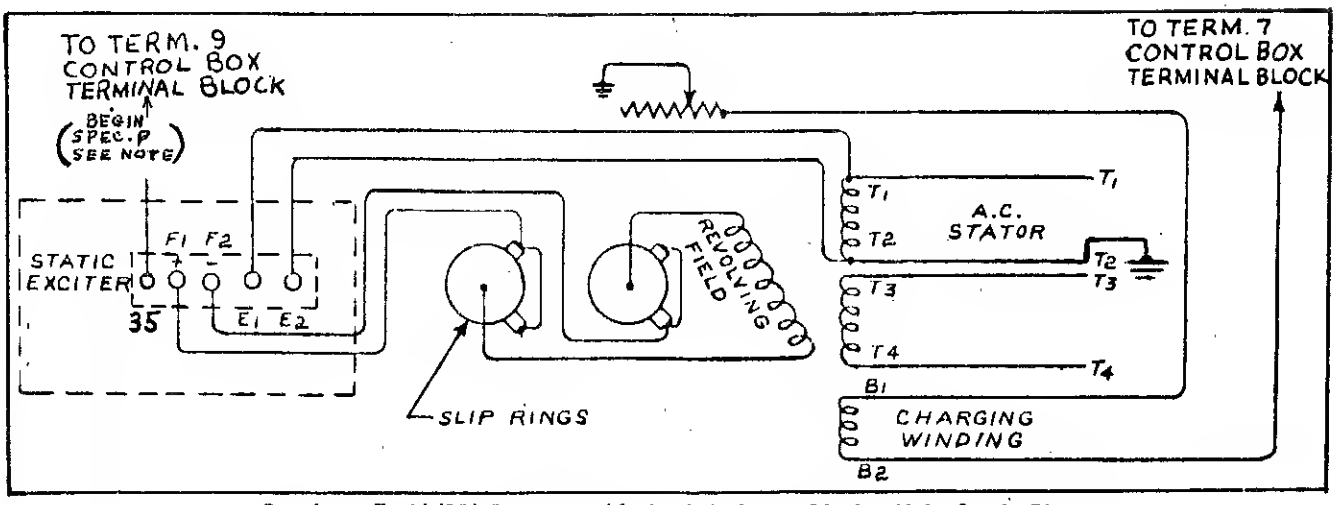
Revolving Armature 4-wire, Three Phase



Revolving Armature 4-wire, Three Phase

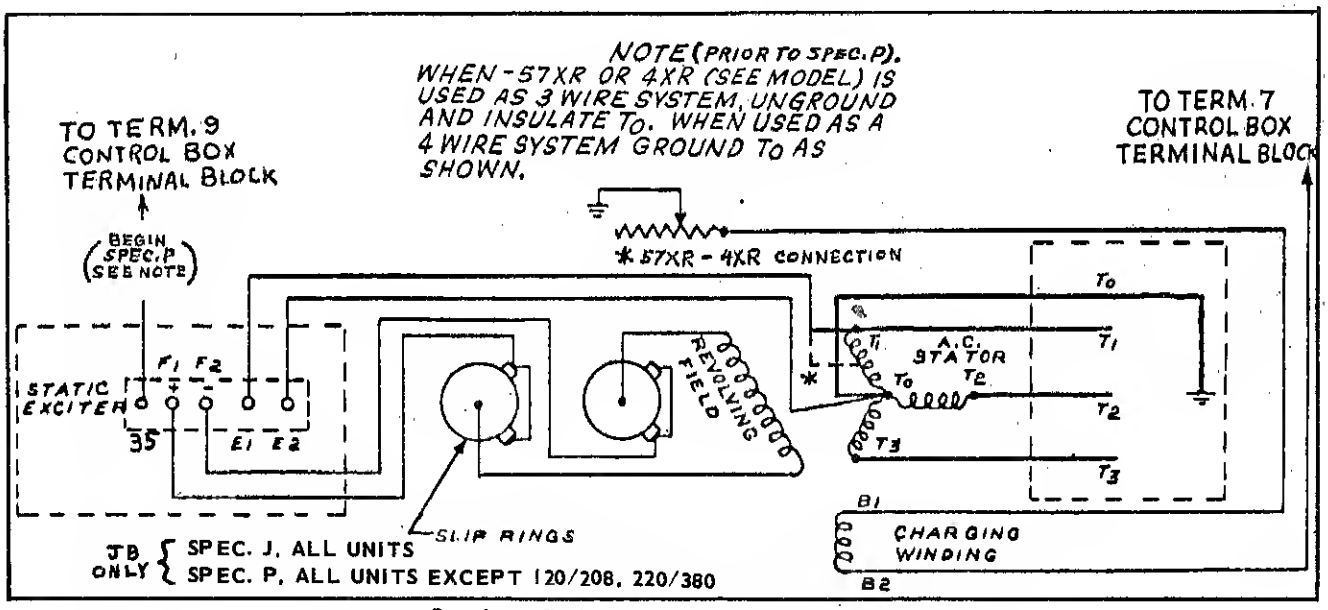


Revolving Armature 3-wire, Three Phase



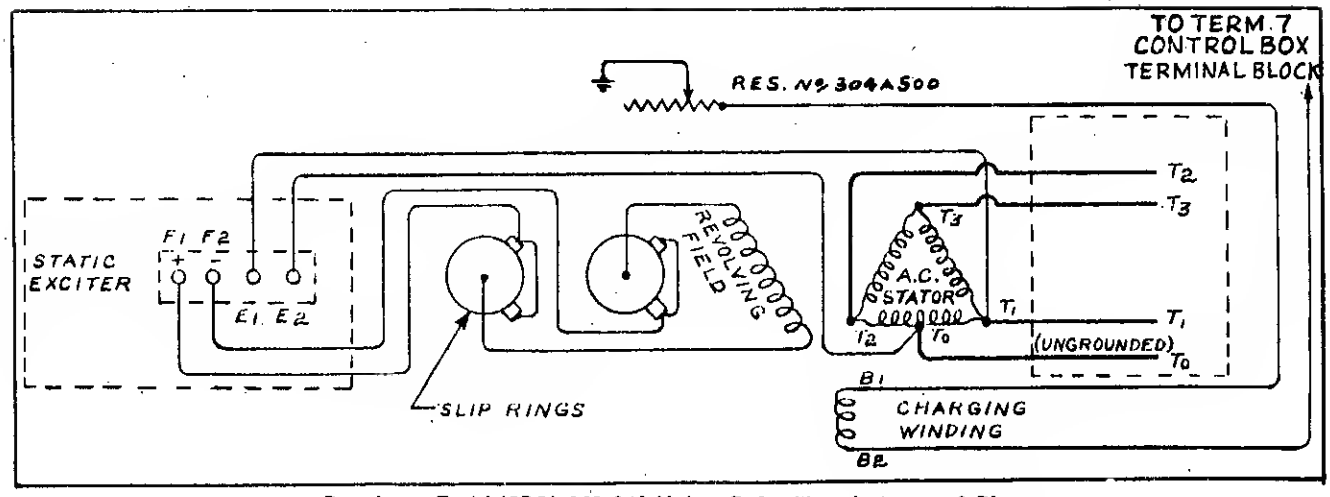
Revolving Field (3R) Reconnectible for 120, 240 or 120-240 Volt, Single Phase

NOTE: T2 must be grounded if the field boost circuit is to work. Any other ground may damage the exciter, (Negative (-) ground only).



Revolving Field, Wye Wound, 4-wire, 3-Phase
-4R (120-208 Volt), - 4XR (277-480 Volt), - 57XR (240-416 Volt)

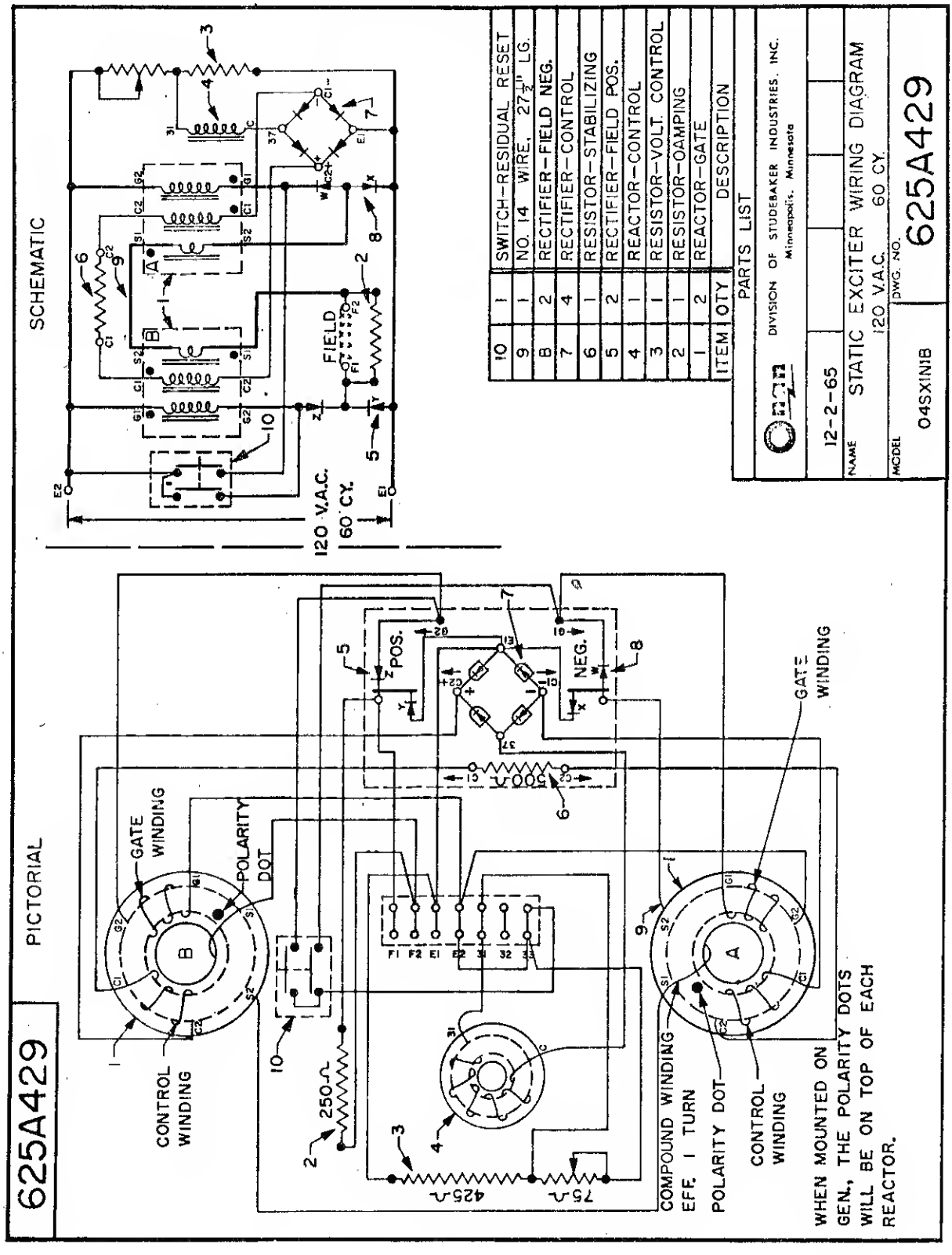
NOTE: T_0 must be grounded if the field boost circuit is to work. Any other ground may damage the exciter, (Negative (-) ground only).



Revolving Field (5DR) 120-240 Volts, Delta Wound, 4-wire, 3 Phase

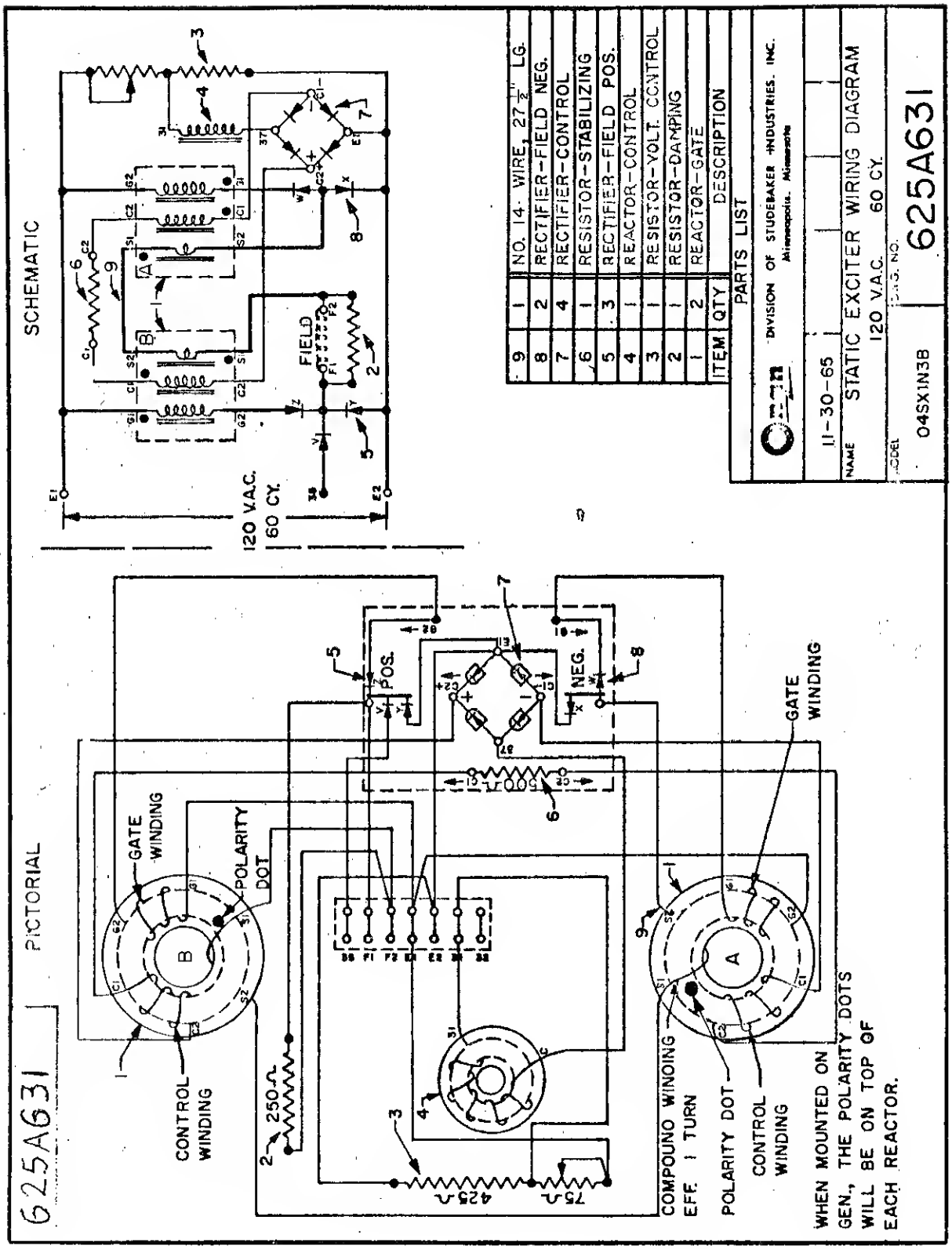
JB ONLY

04SXINIB EXCITER WIRING DIAGRAM



JB ONLY

04SX1N3B EXCITER WIRING DIAGRAM

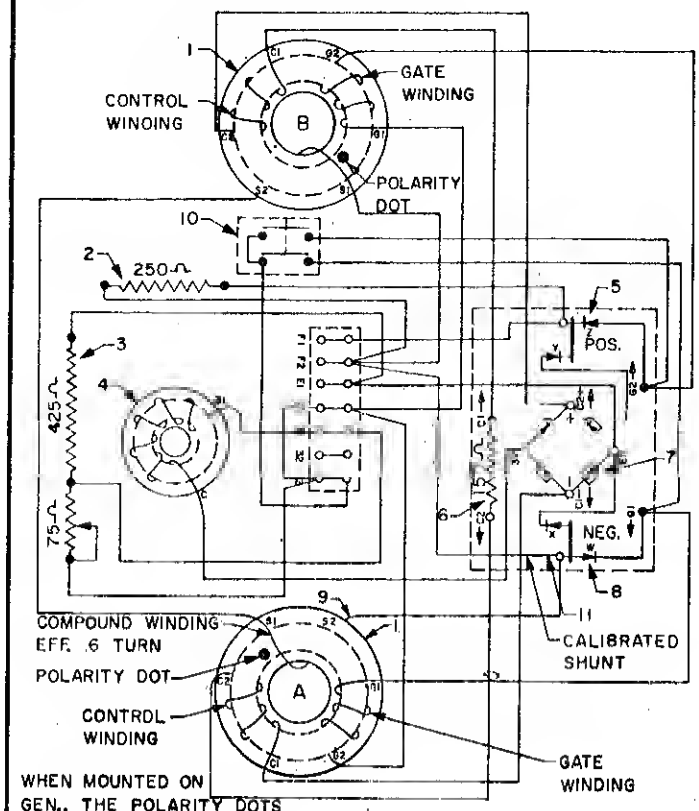


JC ONLY

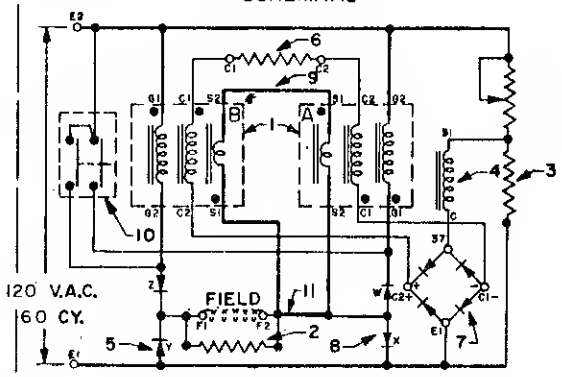
06SX1N1B STATIC EXCITER WIRING DIAGRAM - BEGIN SPEC. C, PRIOR TO SPEC. P.

625A423

PICTORIAL



SCHEMATIC



NOTE: Residual reset switch not used on 06SX1N1A earlier model.

ITEM	QTY	DESCRIPTION
11	1	NO. 16 WIRE, 27½" LG.
10	1	SWITCH-RESIDUAL RESET
9	1	NO. 14 WIRE, 27½" LG.
8	2	RECTIFIER-FIELD NEG.
7	4	RECTIFIER-CONTROL
6	1	RESISTOR-STABILIZING
5	2	RECTIFIER-FIELD POS.
4	1	REACTOR-CONTROL
3	1	RESISTOR-VOLT. CONTROL
2	1	RESISTOR-DAMPING
1	2	REACTOR-GATE

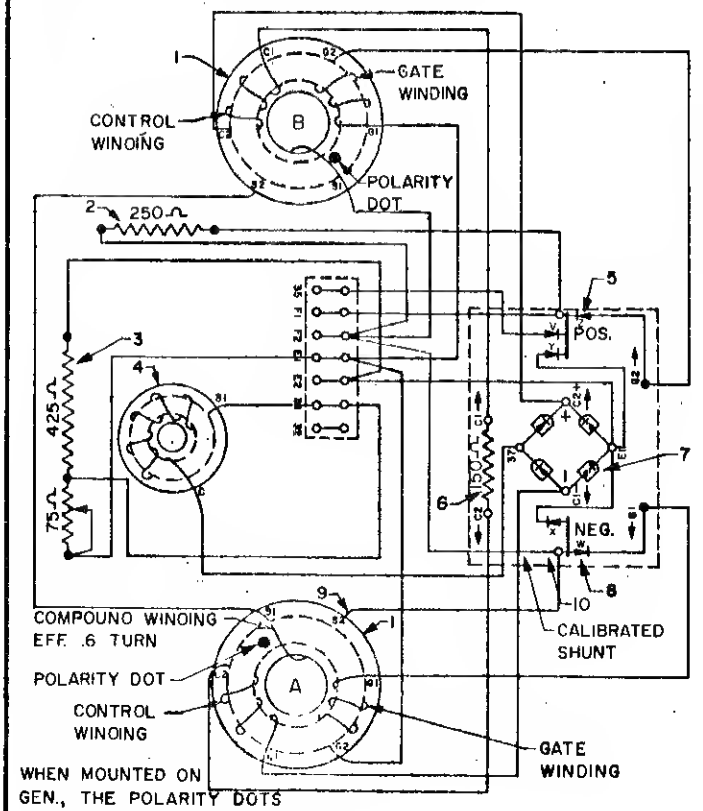
PARTS LIST

NAME	STATIC EXCITER WIRING DIAGRAM 120 V.A.C. 60 CY.
MODEL	06SX1N1B
DWG. NO	625A423

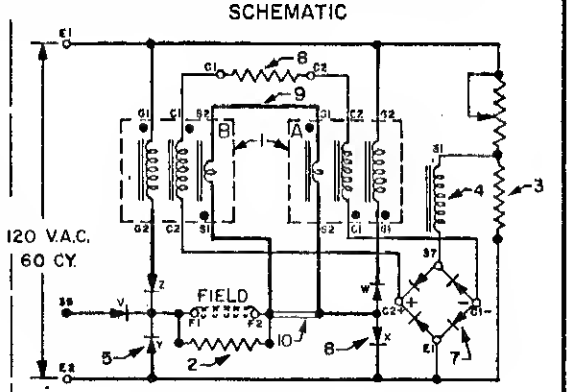
06SX1N3B STATIC EXCITER WIRING DIAGRAM - BEGIN SPEC. P (BEGIN SPEC. L, PENN STATE)

625A632

PICTORIAL



SCHEMATIC

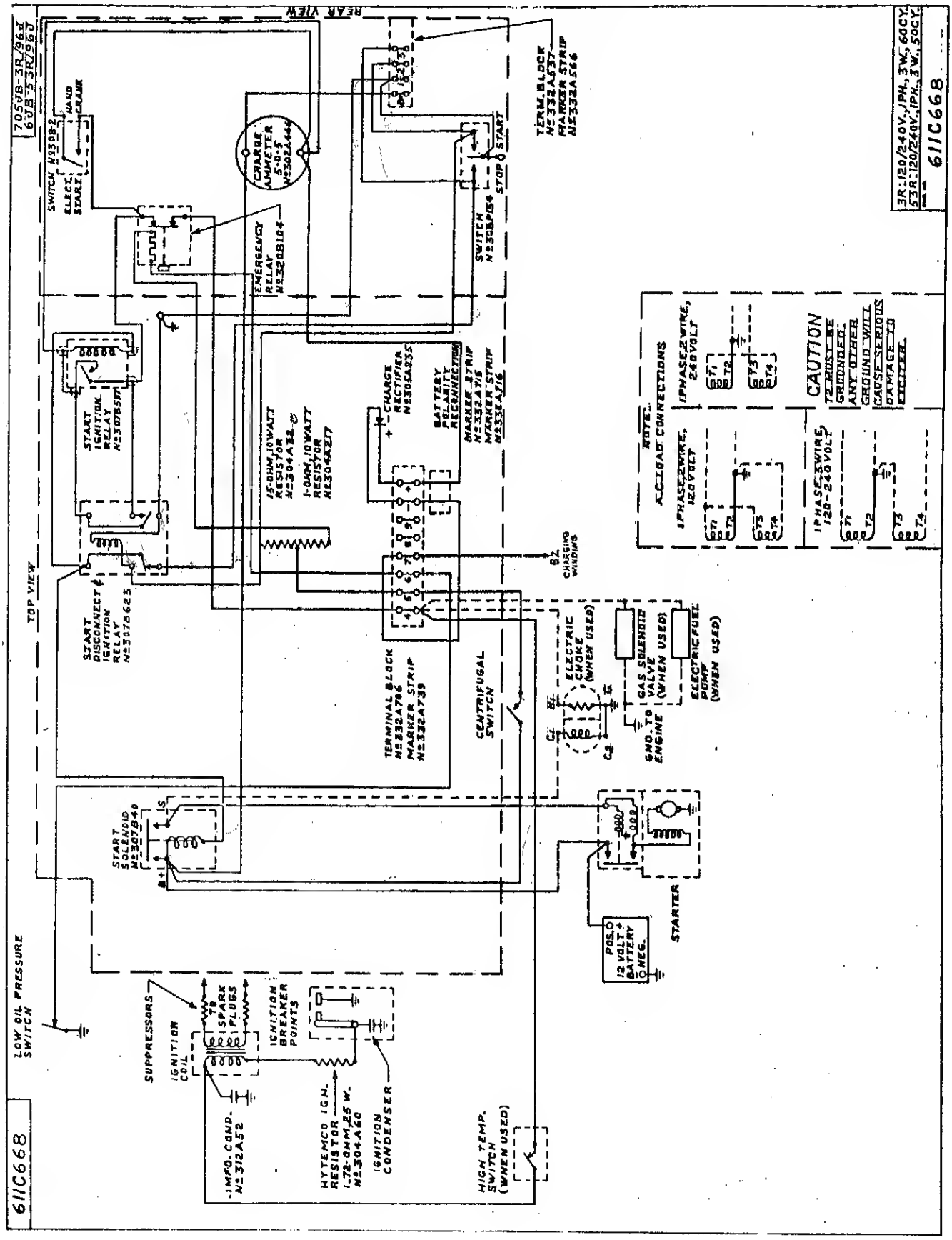


ITEM	QTY	DESCRIPTION
10	1	NO. 16 WIRE, 27½" LG.
9	1	NO. 14 WIRE, 27½" LG.
8	2	RECTIFIER-FIELD NEG.
7	4	RECTIFIER-CONTROL
6	1	RESISTOR-STABILIZING
5	3	RECTIFIER-FIELD POS.
4	1	REACTOR-CONTROL
3	1	RESISTOR-VOLT. CONTROL
2	1	RESISTOR-DAMPING
1	2	REACTOR-GATE

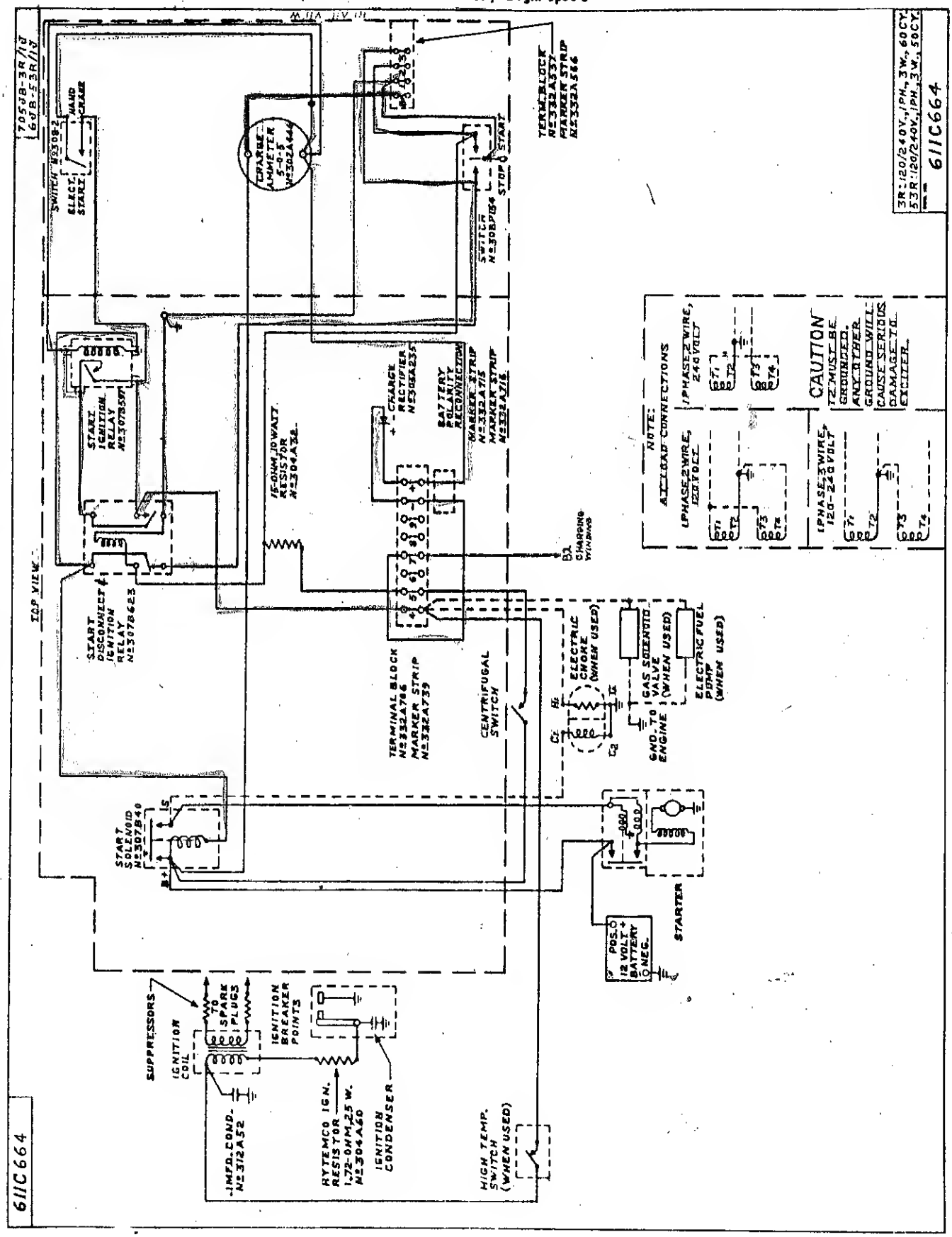
PARTS LIST

NAME	STATIC EXCITER WIRING DIAGRAM 120 V.A.C. 60 CY.
MODEL	06SX1N3B
DWG. NO.	625A632

CONTROL WIRING DIAGRAM 705JB; 50-CYCLE 6JB
(With Low Pressure Circuit) Begin Spec J

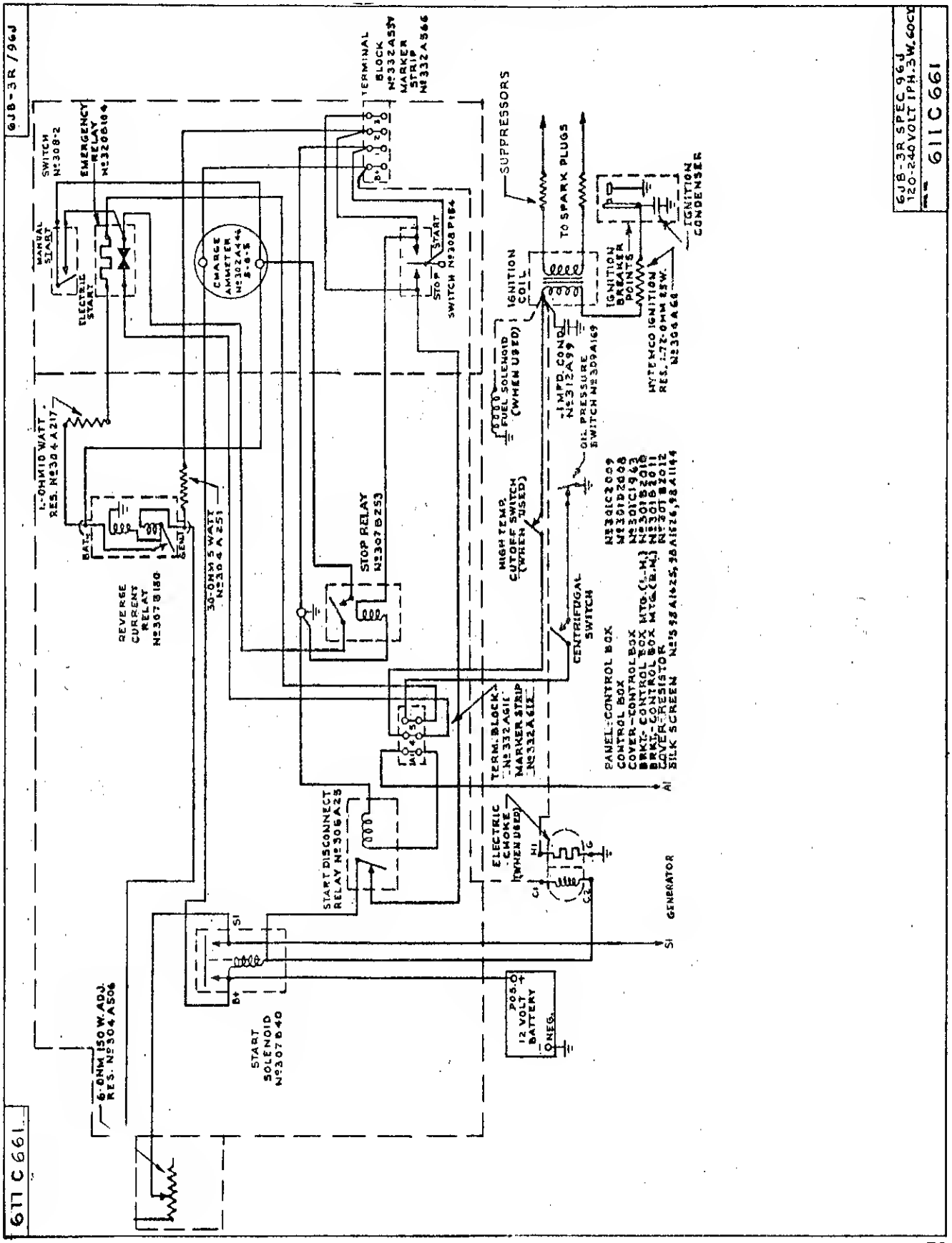


CONTROL WIRING DIAGRAM 705JB; 50-CYCLE 6JB
(No Low Oil Pressure Circuit) Begin Spec J



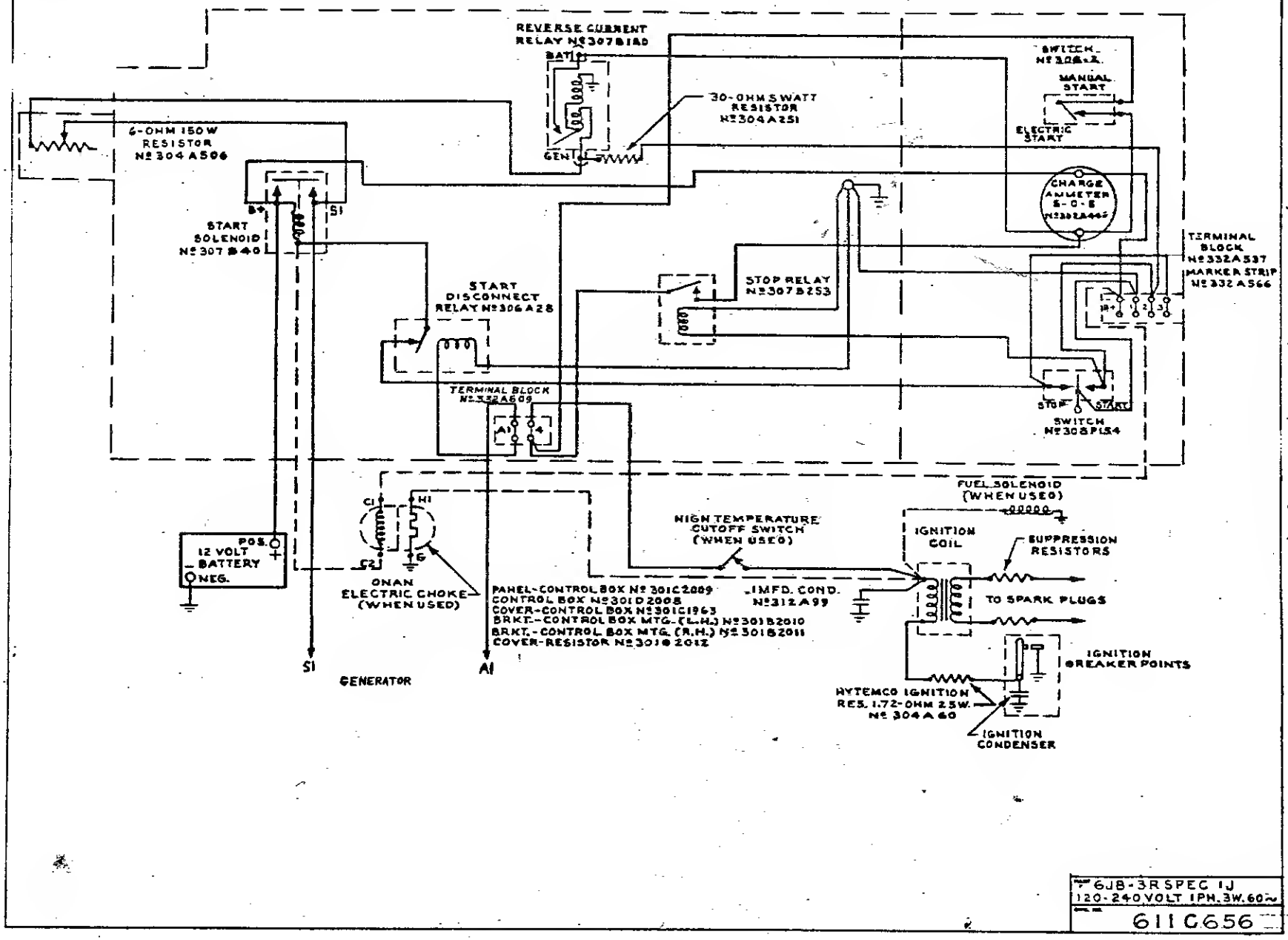
611C664

CONTROL WIRING DIAGRAM 6JB
(With Low Oil Pressure Circuit) Begin Spec J



611C656

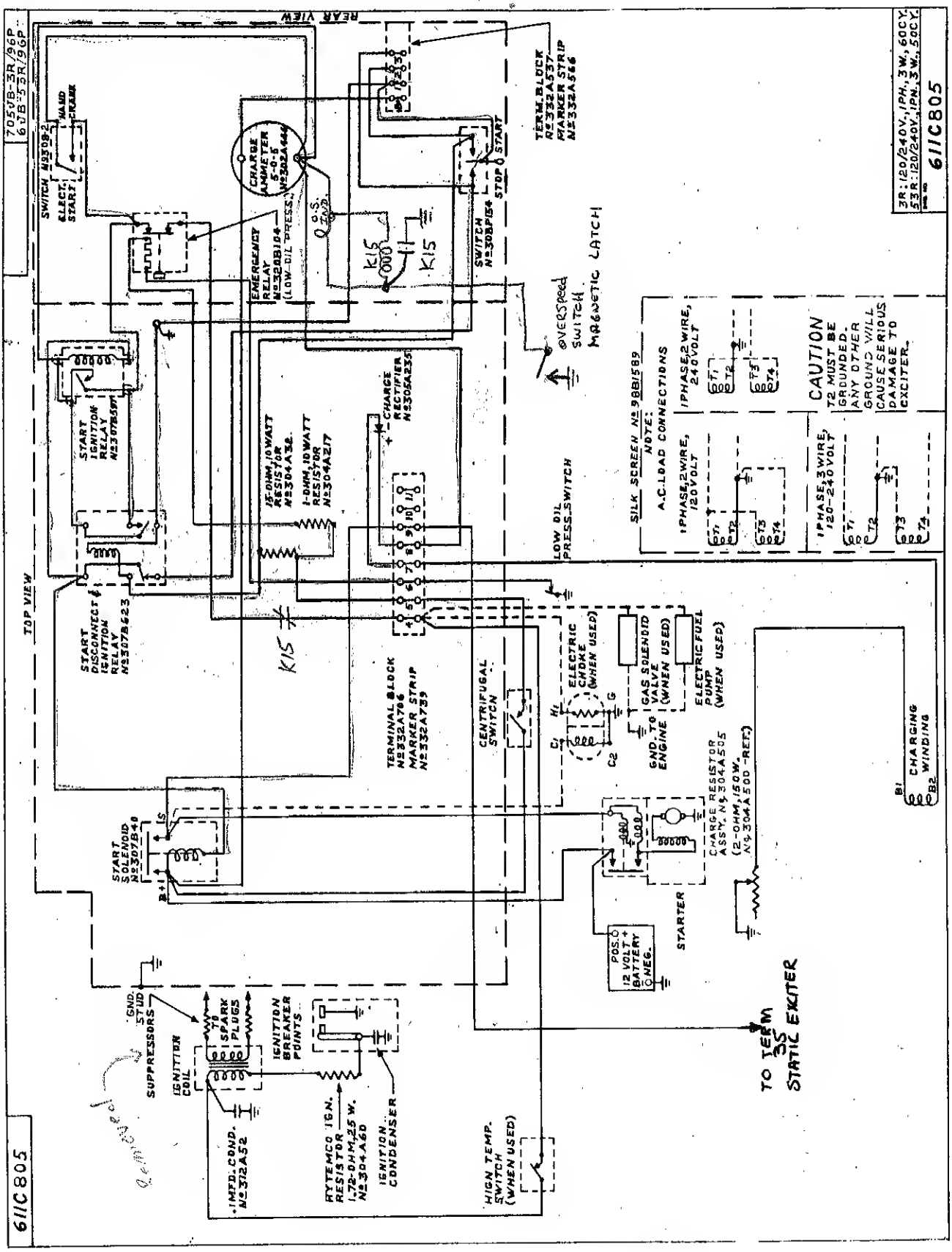
SJB-3R31/1K | 6JB-3R/13J | 6JB-3R/1J



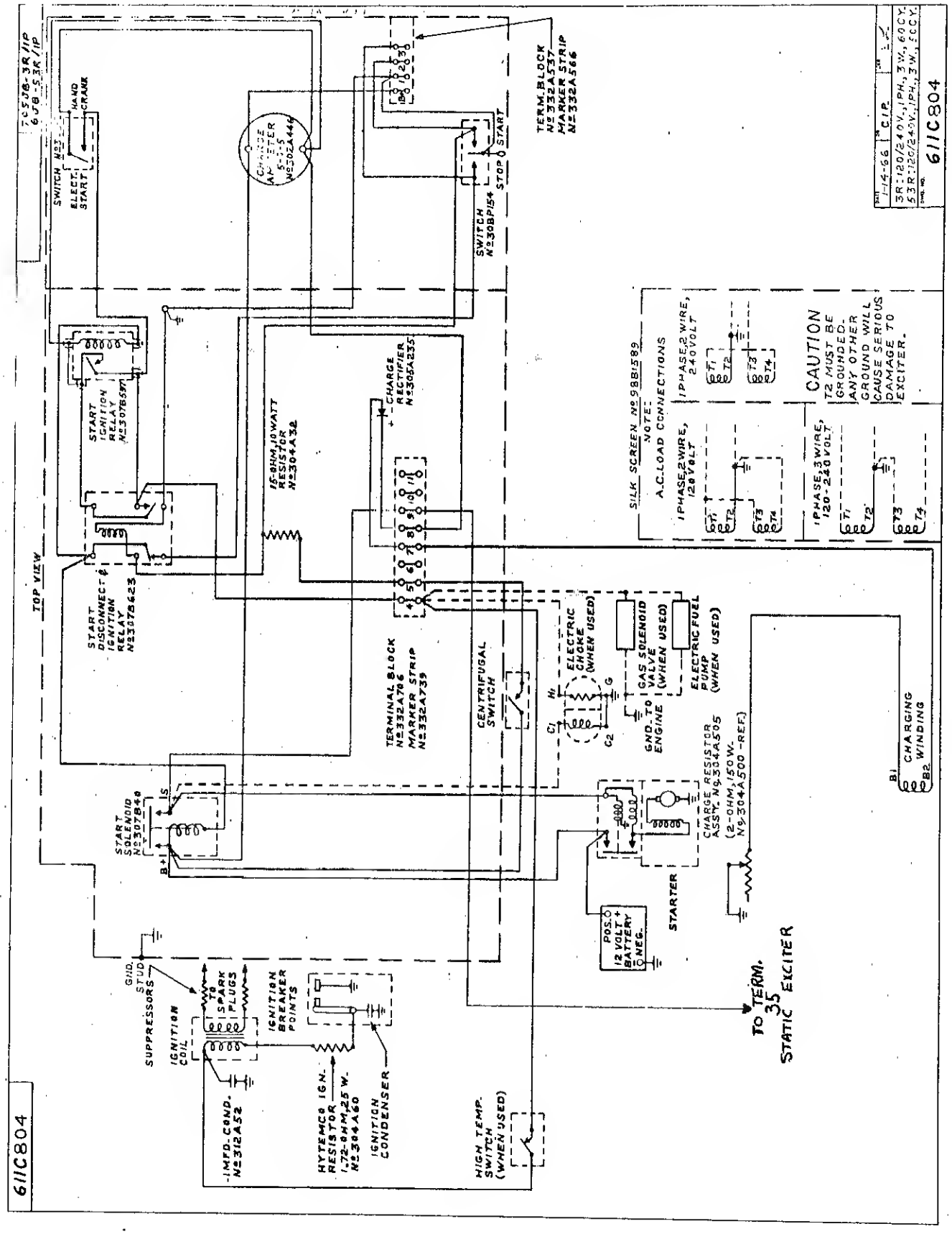
CONTROL WIRING DIAGRAM 6JB
(No Low Oil Pressure Circuit) Begin Spec J

6JB-3R SPEC 1J
120-240 VOLT 1PH. 3W. 60~
611C656

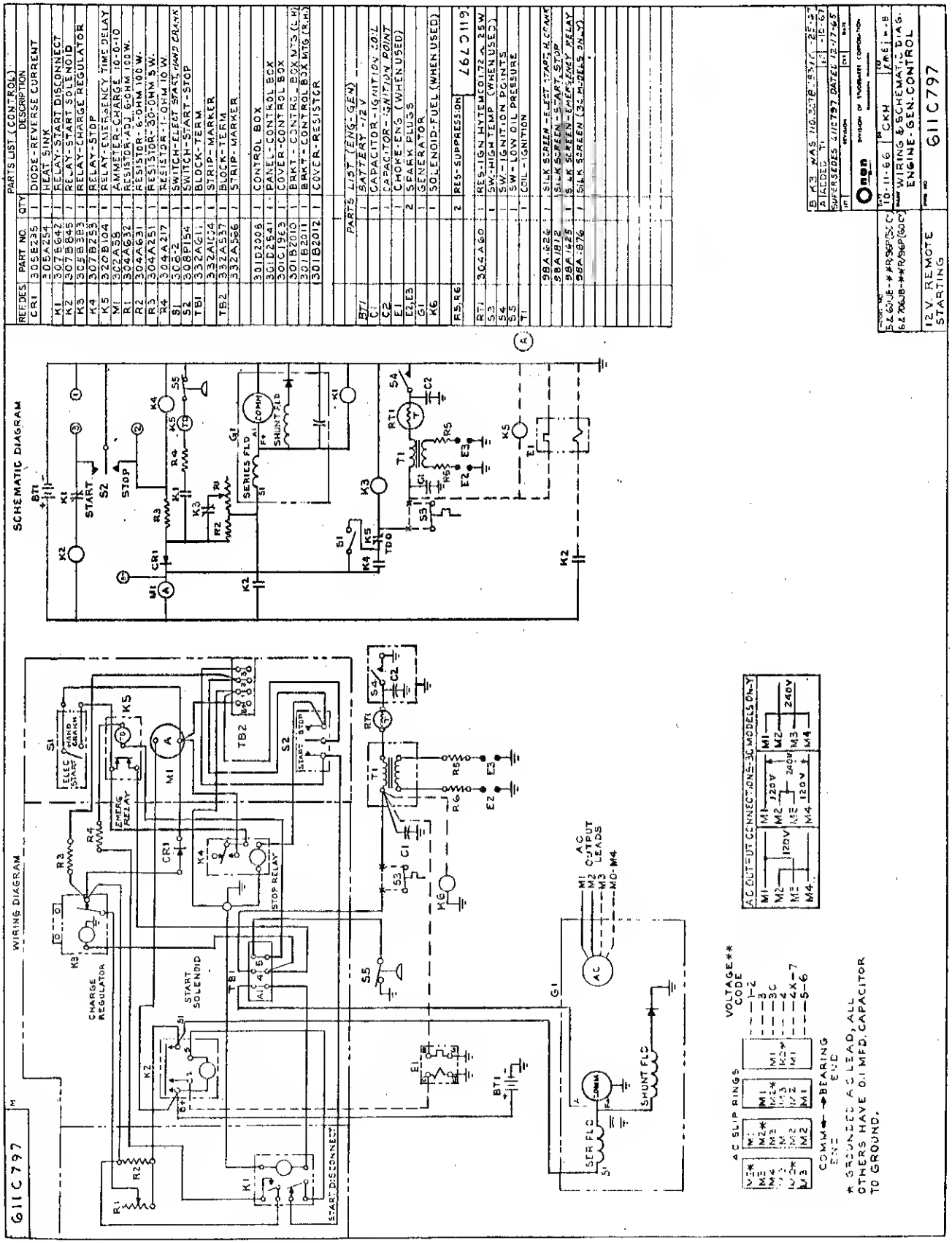
CONTROL WIRING DIAGRAM 705JB; 50-CYCLE 6JB
(With Low Pressure Circuit) Begin 5pec. P



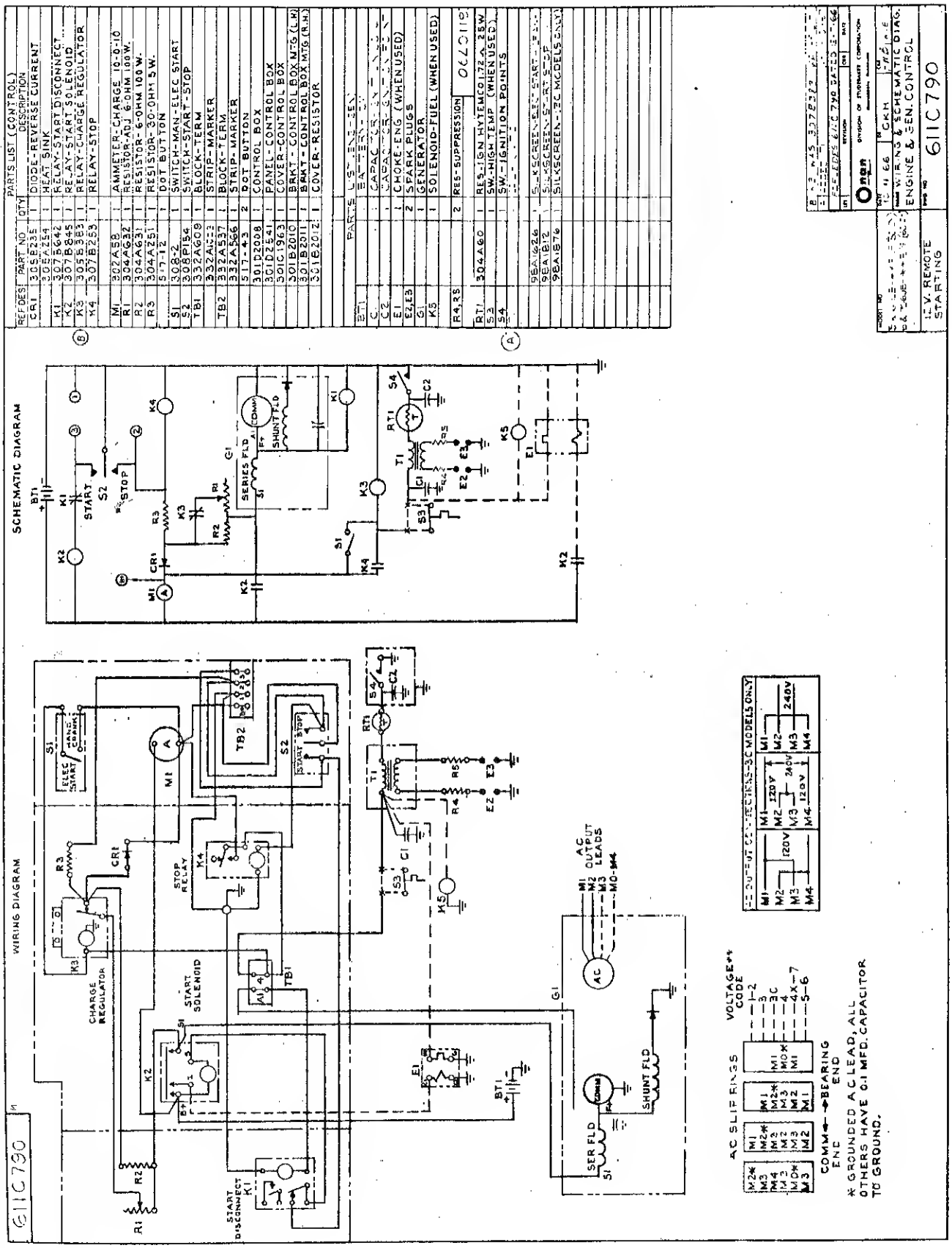
CONTROL WIRING DIAGRAM 705JB; 50-CYCLE 6JB
(No Low Oil Pressure Circuit) Begin Spec. P



CONTROL WIRING DIAGRAM 6JB
(With Low Oil Pressure Circuit) Begin Spec P

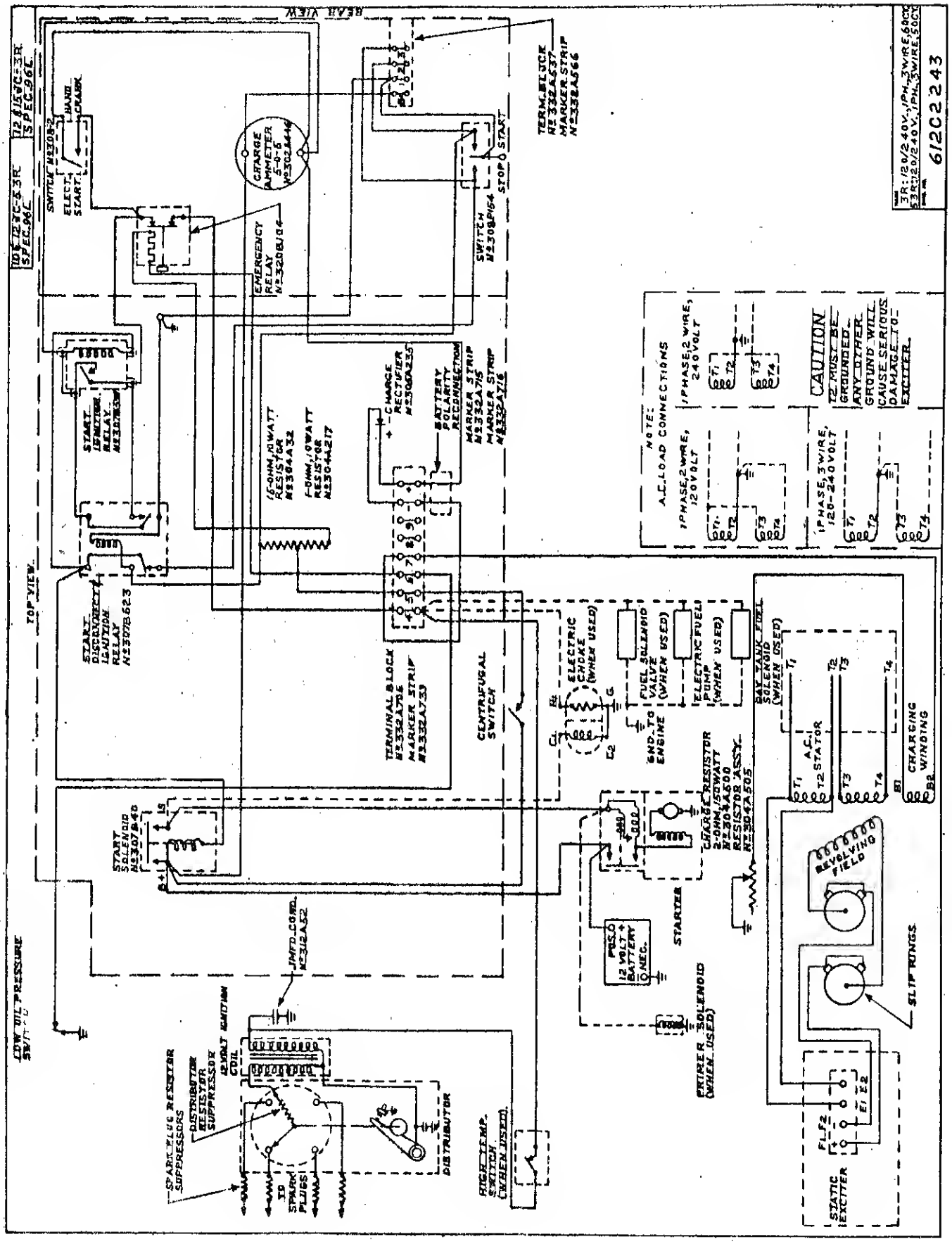


CONTROL WIRING DIAGRAM 6JB
(No Low Oil Pressure Circuit) Begin Spec P

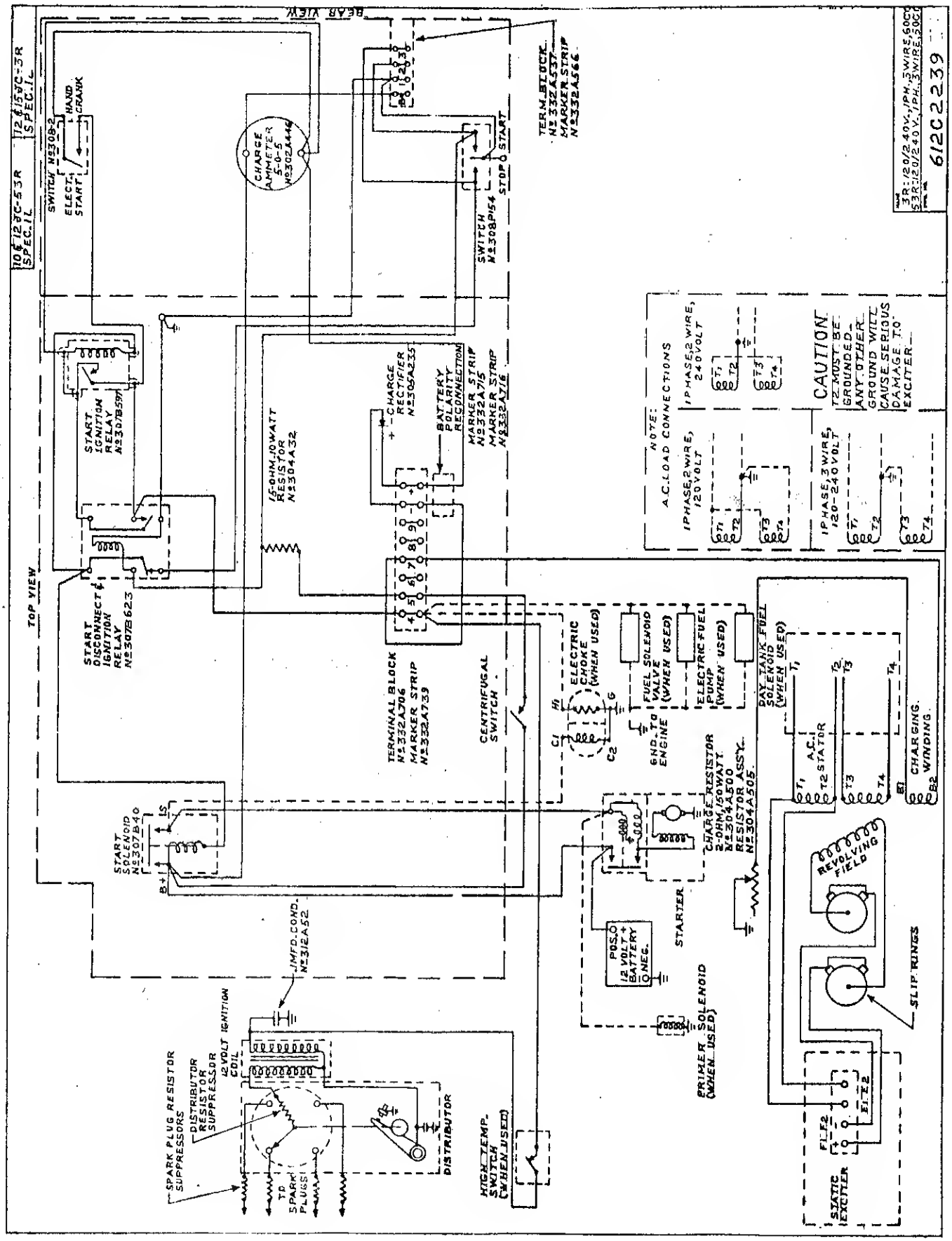


JC

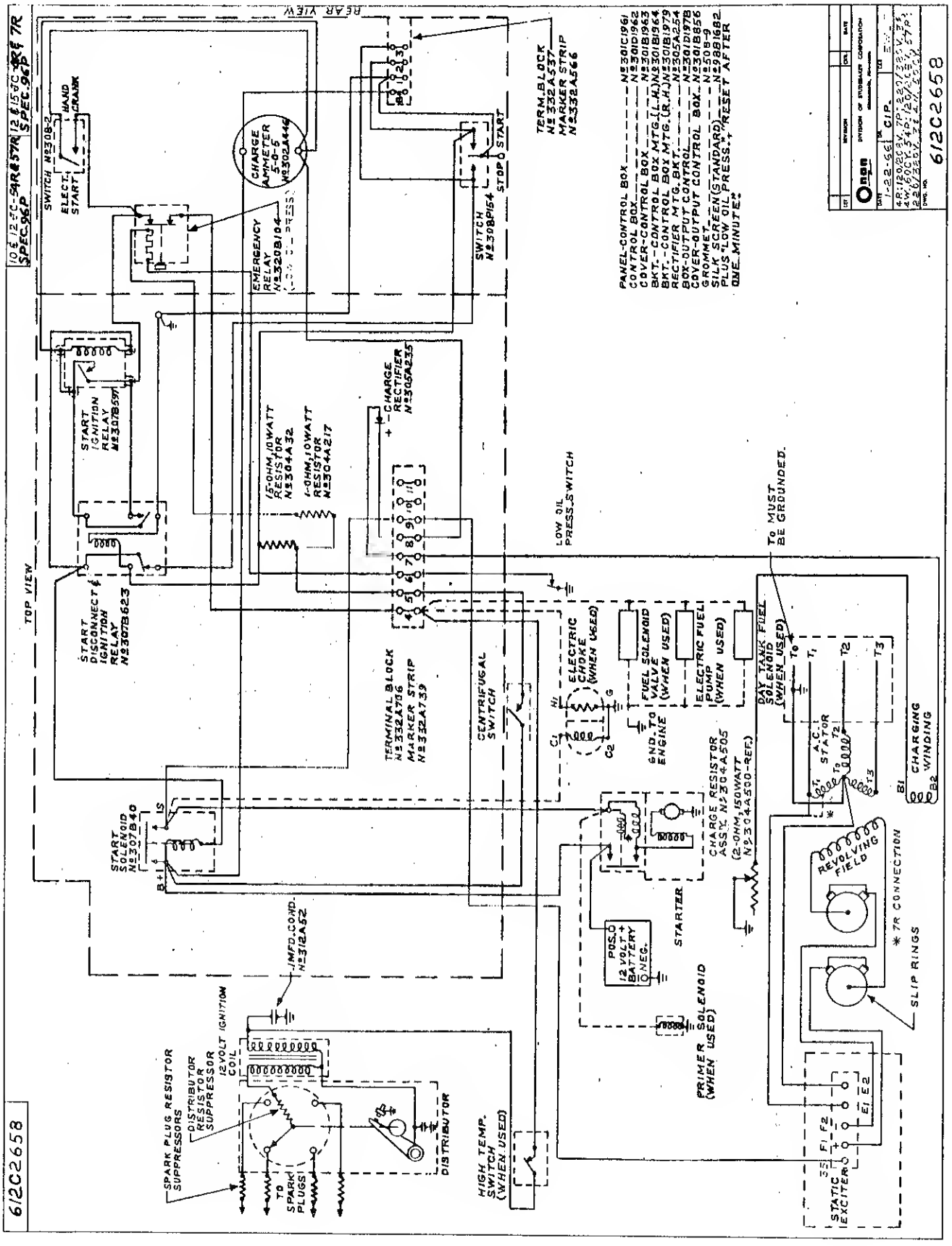
CONTROL WIRING DIAGRAM (Spec L) WITH LOW OIL PRESSURE CIRCUIT



JC
CONTROL WIRING DIAGRAM (Spec L) NO
LOW OIL PRESSURE CIRCUIT



JC
CONTROL WIRING DIAGRAM (Begin Spec. P)
WITH LOW OIL PRESSURE CIRCUIT



JC
CONTROL WIRING DIAGRAM (Begin Spec. P)
NO LOW OIL PRESSURE CIRCUIT